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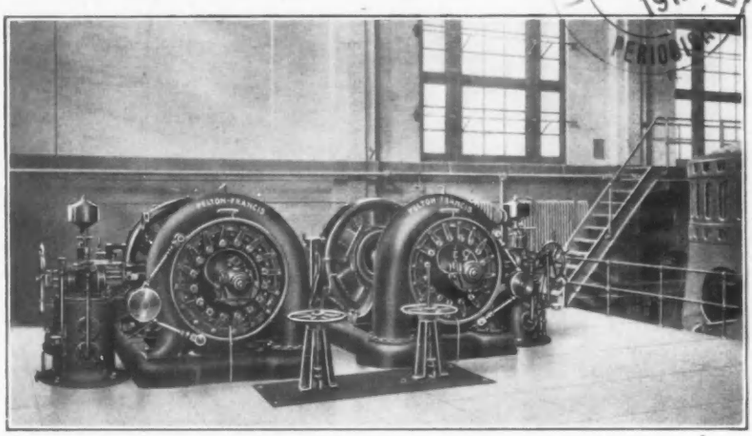

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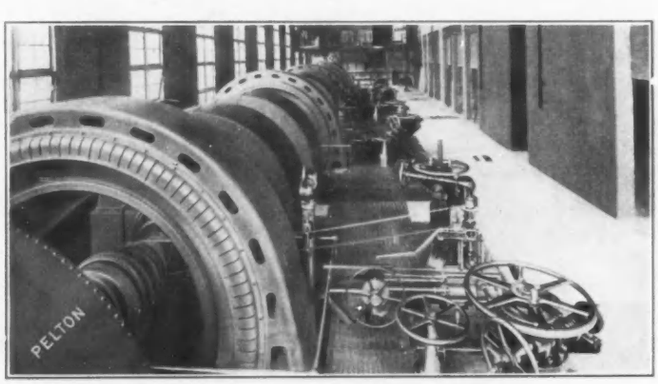

PELTON TANGENTIAL WATER WHEEL INSTALLATION

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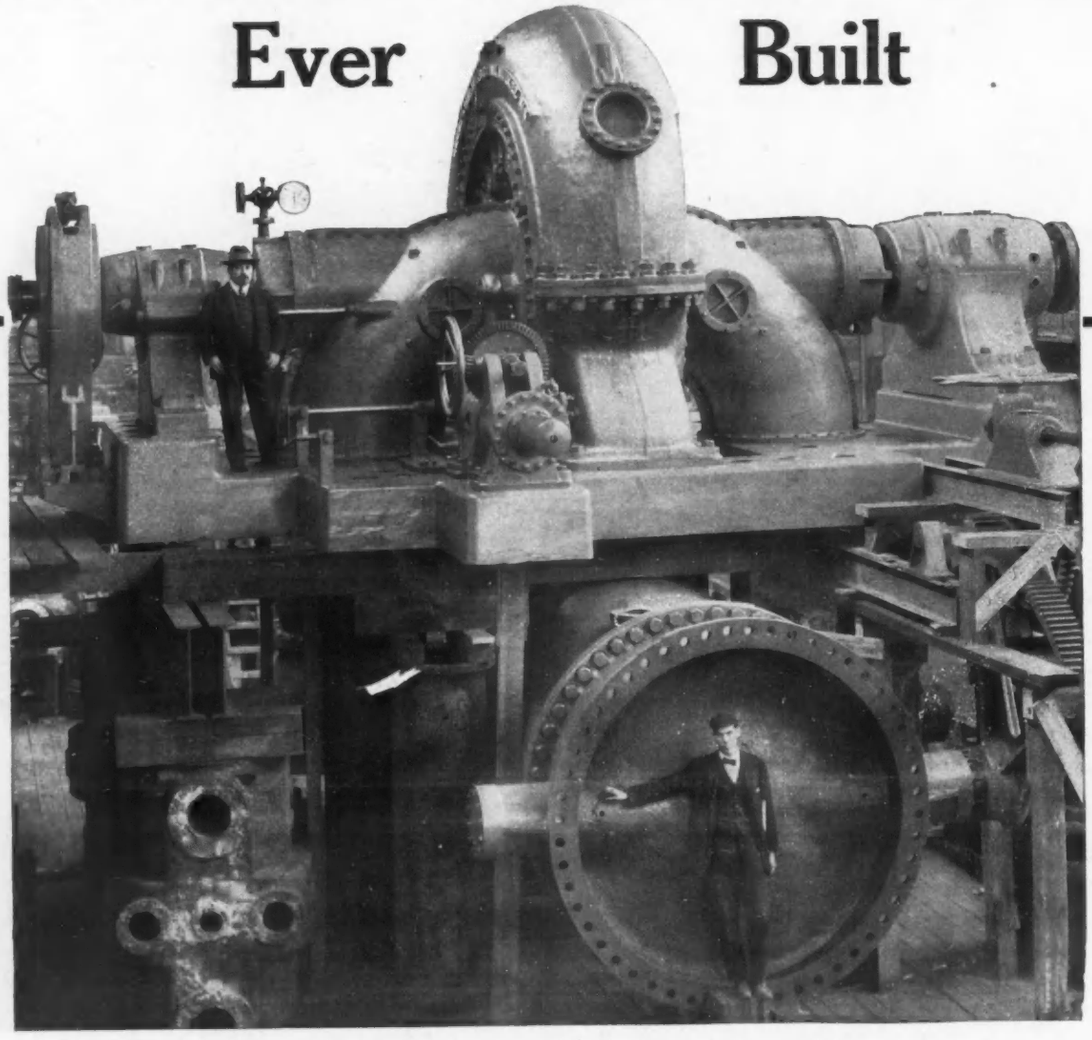
Most Powerful Hydraulic Turbines Ever Built



View of one unit in the erecting shop of Allis-Chalmers Company

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POWER AND GAS
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VOLUME XXVIII SAN FRANCISCO, APRIL 13, 1912 NUMBER 15

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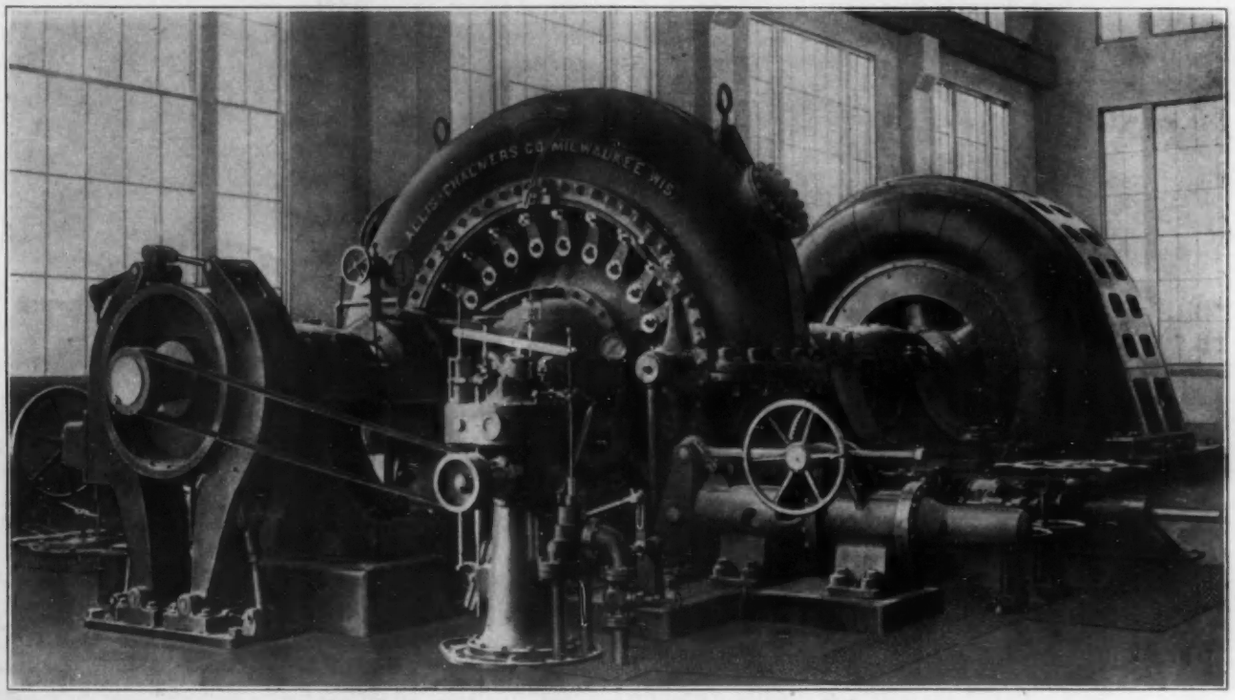
THE WHITE RIVER PLANT

BY ARNOLD PFAU.

About a year ago the Pacific Coast Power Company, of Seattle, now a part of the Puget Sound Traction, Light & Power Company, awarded the contract for the largest hydraulic turbines ever contemplated, the installation being made at their White River power plant about 20 miles east of Tacoma. Each of the two main turbines is designed to develop 18,000 brake horsepower at 440 ft. effective head and 360 r.p.m., but is also capable of delivering 20,400 brake horsepower at a maximum head of 480 ft. and synchronous speed of 360 r.p.m. All parts are designed to withstand the runaway speed at the maximum head of 480 ft. without undue strains upon the material employed. This is the largest high head (reaction) Francis turbine yet designed. The generators are 12,500 k.v.a., 20 pole General Electric water-wheel type alternators supplying three-phase 60 cycle current at 6600 volts. They are connected to their turbines by a rigid flanged coupling.

The turbine is of the inward flow (reaction) type as developed by the Allis-Chalmers Company. To comply with the special wishes of the purchaser, the spiral-case-double-discharge arrangement was adopted.



Interior View of Power House With One Complete Unit in Place.

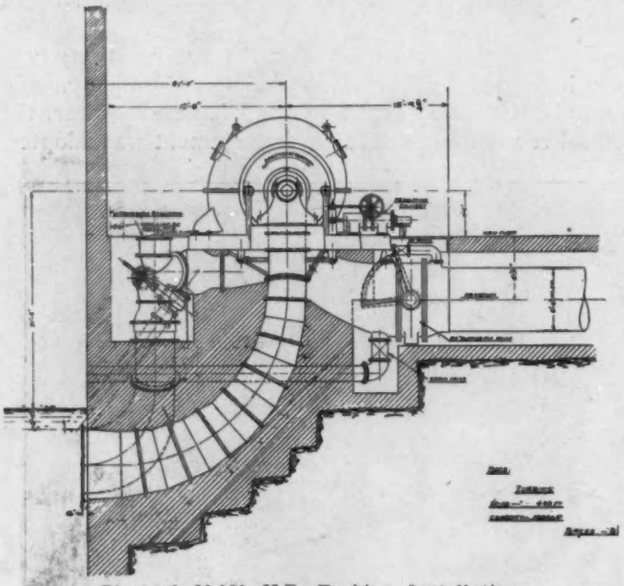
The operating water enters the spiral casing from below, passes through the speed ring and immediately upon entering the runner is divided in two discharges with separate quarter turns and steel plate draft tubes.

The spiral casing is made of two halves rigidly bolted together in a horizontal plane through the center line of the shaft. It is made of cast steel to withstand a test pressure of 385 lb. per sq. inch, and is annealed to increase its resistance against any positive and negative pressure variations which may occur in exceptional cases of severe load changes. Proper man-

holes are provided and also taps for pressure gauges, pitot tubes for research work. Opposite the inlet pipe an outlet branch pipe is provided which connects to the Y pipe of the pressure and the governor operated pressure regulators.

This spiral casing has a span of 16 ft. and diameter of inlet pipe of about 5 ft., being the largest cast steel casing ever built for use with a head over 400 ft., and consequently a number of interesting problems had to be solved by the designers, in order to insure economy in manufacturing, and at the same time employ the proper amount of material to withstand the stresses caused by the tremendous resulting forces within safe limits.

The water passing through the spiral casing enters the speed ring in approximately radial direction. It thus leaves the inner ring of the casing open and would impose considerable strain upon the material. To efficiently reduce this strain a speed ring of annealed cast steel is bolted to the inner opening of the



Plan of 20,000 H.P. Turbine Installation.

spiral casing and through its substantial webs forms a solid cross connection without obstructing the water passages.

The two inner flanges of the speed ring carry the speed gate covers, which are bolted to the quarter-turns and bored out to receive the bronze bushings forming the bearings for the pivoted guide vanes. The inner radial faces are lined with removable facing rings, which are subject to wear due to the grinding effect to be expected on account of the existence of glacial silt carried by the "White River," from which this plant is operated.

Due to the high velocities allowable in spiral cases under high head, special care must be taken that all obstructions to the free water passage are avoided and it is therefore, necessary to keep all coving or sliding elements outside of the casing where they can be readily inspected and lubricated. The so called "outside gate rigging" has, therefore, been adopted.

If any foreign matter between two guide vanes prevented their closing, the governor would concentrate its full energy upon these two guide vanes and their stems, levers and links and would deform and damage them unless they are proportioned accordingly. This would call for dimensions of stems which would seriously interfere with the proper design of the guide vane bodies and unnecessarily increase the friction of the whole gate rigging. The guide vane stems and levers are, therefore, proportioned to only resist the pressure and strain resulting from the water pressure. To prevent the governor from imposing destructive strains upon the connecting links between shifting ring and guide vane levers, the links are made of such a cross section as to break at a predetermined stress. The levers are easily removable so that an exchange of links can be effected in a very short time.

The guide vanes are so designed that they have a tendency to close to an opening at which the turbine will operate without load at about normal speed. A breakage of two links can, therefore, not materially affect the speed of the turbine and the two links may, therefore, be exchanged without necessitating a shut down of the unit.

The runner is made of one solid steel casting carefully machined, perfectly balanced and the water passages made to template so that the actual areas deviate fractions of a per cent only from the working drawings. The runner is bolted to the concentric flange of the turbine shaft and the units are locked and protected against corrosion from the discharging water by means of machined cover rings which at the same time form a smooth guide and, together with the walls of the quarter turns, insure correct flow lines of the discharging water columns.

The cast iron quarter turns are of liberal sweep split vertically to enable quick access to the discharge side of the runner and being bolted to the base plate, rigidly brace the turbine casing and thus increase the stability of the whole unit. Proper manholes are provided for inspecting the interior.

The shaft is of solid open hearth forged steel and rests in two generator type ball and socket seat ring oiling bearings. The driving end in the bearing has a diameter of 16 inches, increasing to 32½ inches at the center flange to which the runner is bolted. The opposite bearing serves as a thrust and steady bearing, three substantial thrust collars being forged with the shaft in one piece.

An automatic water sealed box has been adopted and is so arranged that it may operate either at overpressure in the quarter turn or under vacuum. Revolving disks are combined with stationary chambers connected to either circulating water pressure supply or to drain pipes connected to the draft tubes.

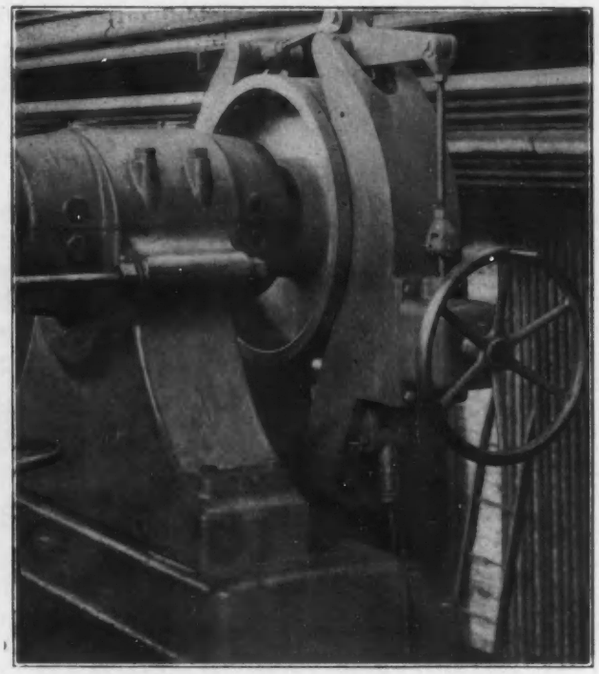
The end thrust caused by turbines of such size and power would, if taken up by mechanical thrust bearings, call for dimensions which are commercially prohibitive. It is, therefore, necessary to balance the revolving element automatically. This is relatively easily accomplished with double discharge runners of the type used here. The speed gate covers, which also serve as discharge rings, form pockets between the covers and the runner walls and are so designed

that the runner floats inside on pressure cushions which in themselves are powerful enough to counteract any mechanical end thrust which may ever be caused by the runner.

The base plate forms the top of the drain tubes, and the steel plate draft tubes proper are bolted to the base plate by means of angle steel flanges. The draft tubes are all concreted into the foundation. They form a tapered elbow of long curvature and lead the discharge water horizontally into the tail race pit outside of the power house.

Hand-Operated Friction Brake.

The turbine shaft carries the friction brake pulley and the brake yoke is mounted upon the extended foundation base plate. This brake is designed to bring all the revolving elements, at closed turbine gates with



Mechanical Handbrake for 20,000 H.P. Francis Turbine.

casing under full pressure, to a stop from full speed in five minutes and the friction surface and pressure is such that under the above conditions all the heat produced is safely carried off to prevent excessive heating.

Butterfly Valves.

Since each main turbine has its independent pipe line it was not necessary to provide for a gate valve, because the feeder pipe belonging to this unit can be emptied without interfering with the other unit. In case of accident, however, where a quick closing off of the water supply is imperative it is desirable to have some means in the power house for immediate action. For such purpose a butterfly type of valve is very satisfactory, provided that it is so designed that it is sufficiently tight to enable inspection of the interior of the entire turbine.

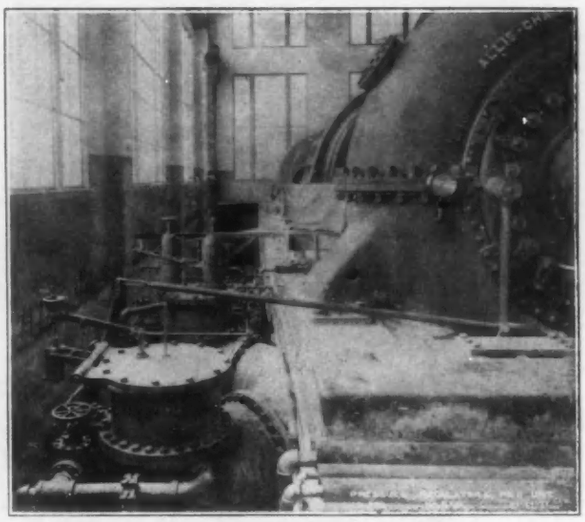
A cast steel butterfly of 84 in. free passage diameter is, therefore, inserted between the feeder pipes and the turbine. It is located below the power house floor and connected to the taper inlet pipe between the same and the spiral casing.

The gate can either be operated by a mechanical hand regulating device or by a direct current motor with starter, either close to the turbine or from the switchboard gallery. Under normal conditions a bypass valve may be opened for filling the turbine casing and balancing the butterfly valve, in which case a gear ratio is used by means of which the valve can be operated quickly.

A drain valve is placed at the lowest point of the inlet pipe by means of which the whole unit can be completely drained, or the leak water discharged.

Regulating Cylinder and Mechanical Hand Regulating Device.

Economy of water is of main consideration with the operation of this power plant. It is, therefore, logical to use water for controlling the load fluctua-



Governor and Pressure Regulators 20,000 H.P. Francis Turbine.

tions of the power system. Special attention had to be paid to the problem of speed regulation, and all parts concerned are designed and built for the highest economy and reliability. The horizontal regulating cylinder is mounted upon the main base plate of the turbine by means of two substantial brackets, one directly supporting the regulating cylinder and the other supporting the guide of the crosshead of the regulating piston. The piston rod projects through the front and rear cylinder covers, carrying at its rear end a gate opening indicator and at its front end a substantial cross-head which receives that component force which results from the inclined position of the connecting rod between cross-head and regulating lever at mid and end positions of the regulating piston.

To enable inspection or repair of the regulating piston or other parts of the governor without necessitating a shut down of the whole unit, an independent mechanical hand regulating device is used, placed above the regulating cylinder and so connected with the extended regulating lever that it can be conveniently thrown in or out of commission.

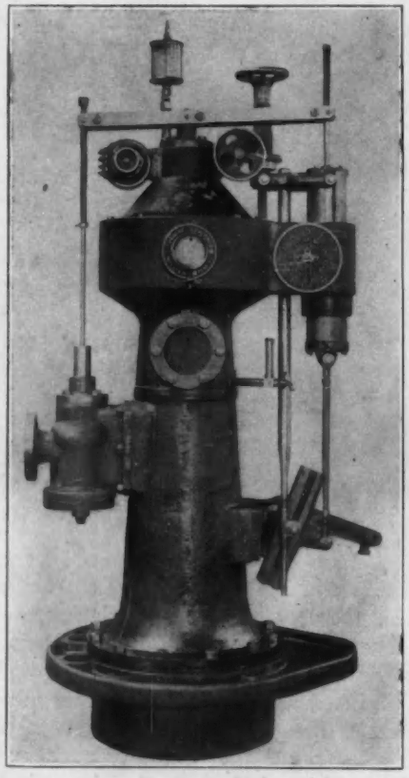
In power plants with units of such size and a power system of such magnitude, it is permissible to have one or a few units operating on the line without taking part in the speed regulation. An independent mechanical hand regulating device is, therefore,

of considerable commercial value in so far as it permits the use of the unit and the furnishing of power even during inspection or repairing of the automatic governor.

Automatic Governor.

The governor is of the oil pressure type, the operating oil being furnished by a central oil pressure system.

The governor stand is conspicuously located on the generator floor. It carries the speed control or flyballs, the floating lever, regulating valve, compensating-relay-dash-pot and synchronizing attachment or switchboard control. The flyballs are completely encased so that no revolving parts are visible except the flyball drive pulley. They are of the equilibrated spring type, of extreme sensitiveness and stability with



Hydraulic Turbine Governor.

springs adjusted in strict accordance with the characteristics required. The governor motion is transmitted on top of the housing to the floating lever. A sight feed oil cup of liberal capacity enables continuous and perfect lubrication of all revolving elements so that highest sensitiveness together with maximum energy is obtained. The regulating valve is double acting and hydraulically balanced so that practically no energy is required to raise or lower the valve stem connected to the floating lever. Since the flyballs are extremely sensitive and at the same time produce considerable energy, it is evident that the smallest speed variation will suffice to move the regulating valve stem and consequently the gates of the turbine. A speed variation of 1/5 of 1 per cent is sufficient to cause a motion of the gates so that the speed regulation will be of the highest accuracy obtainable. The regulating valve is returned into its mid or "dead beat" position by means of the floating lever operated from the compensating relay dashpot. The dashpot receives its motion from the relay connection of the regulating piston. The compensating relay is a combination of a relay of fixed long stroke and a relay of short adjustable stroke so connected to each other that the large stroke acts first upon the floating lever and the small stroke acts relatively slowly thereafter, thus gradually readjusting the position of the floating lever to that of the small relay stroke and consequently of a small difference between the former speed and the present one corresponding to the new load or gate opening of turbine. The small secondary relay stroke can be adjusted according to the desired maximum speed difference between friction load and full load of the turbine, and can be set for any percentage between 4 and 0, the latter, however, is not possible for alternating current generators running in parallel with each other as the total absence of speed variation would cause a floating of the load between the generators concerned.

The synchronizing attachment control consists of a small d.c. motor operating the relay of the governor so that the gate opening may be increased or decreased electrically from the switchboard and thus a synchronizing of the units is made possible. The relay can also be hand operated and the turbine regulated with oil pressure by hand from the generator floor.

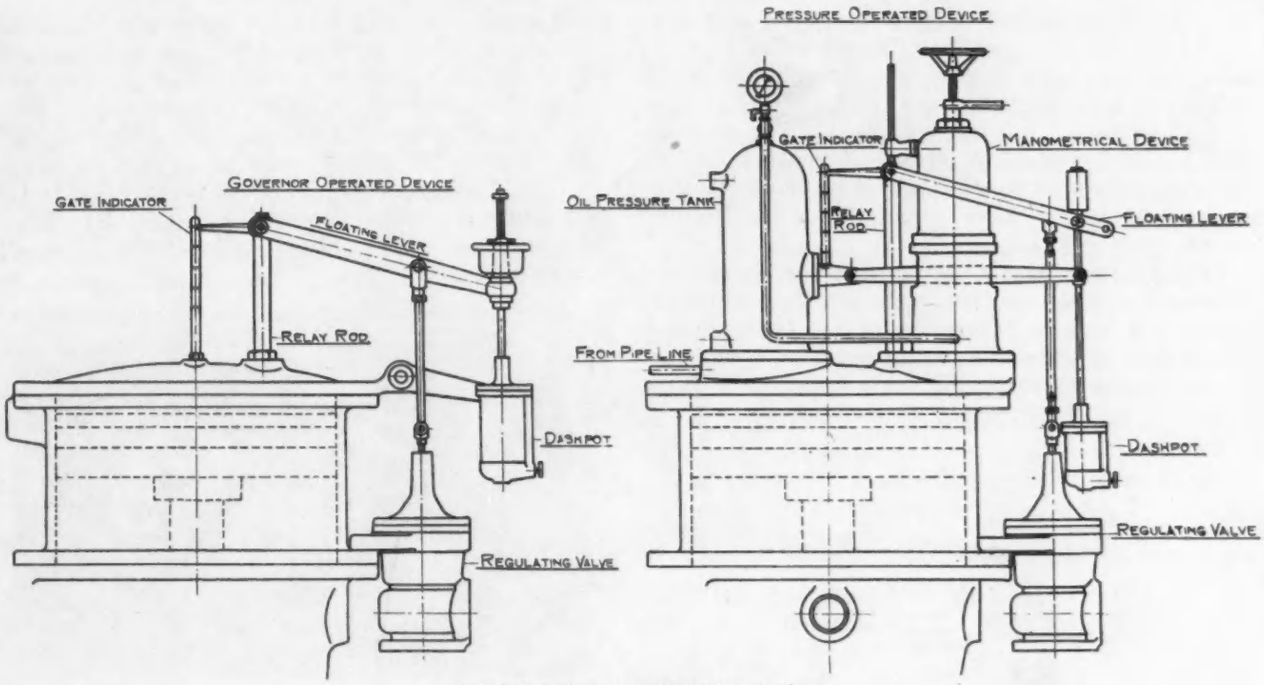
Load Limiting Device.

In order to limit the maximum gate opening of the turbine, when regulated automatically, a load limiting device is provided so that the governor is prevented from opening the turbine gates beyond a desired amount. A lever and adjustable rod is connected to the relay shaft and operates a fork which prevents the valve stem from dropping below a certain fixed position. The adjustment of the length of this rod determines the desired limit of gate opening.

Governor Operated and Pressure Operated Pressure Regulators and Bursting Plates.

In order to protect the pipe line against serious pressure rises and to assist the governor in obtaining close speed regulation, devices must be provided to prevent pressure rises or surges of the water column. This is accomplished by the use of pressure regulators which are both governor and pressure operated, and to protect the pipe line in case of failure of either of these devices, a bursting plate is provided.

The pressure regulators are of Allis-Chalmers Company's typical design. A "Y" pipe is connected to the bottom branch of the spiral casing below the generator floor. One branch of this "Y" pipe leads to the governor operated pressure regulator, the other to the pressure operated pressure regulator and the neck of the "Y" pipe connects to a hand operated gate valve which at its lower end, carries the bursting plate and its discharge pipe. While the discharges of the two pressure regulators are united by a "Y" to a common flaring steel plate elbow, for reasons of economy of space available between the two turbine draft tubes, the discharge pipe from the break plate empties independently into the tail race pit.



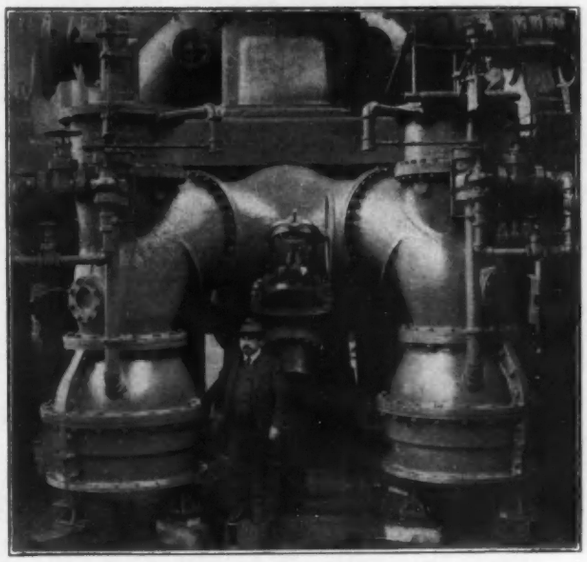
Details of Governor Operated Device.

Both pressure regulators consist of a main valve and of the mechanics to operate it. The main valve is of identical design with both pressure regulators while the mechanisms attached to it are governor operated in one case and pressure operated in the other.

The main valve consists of an elbow which, at its lower joint, holds a circular bronze bushed ring against which is pressed a flaring disk held up by a stem connected to a piston located in the bronze bushed cylinder above the elbow. When the disk is lowered the water discharges vertically downward and the shape of the discharge ring and the disk valve is made so as to cause a flaring discharge of the water and thus tends to spray it. This results in an efficient reduction of the impact. The load resulting from water pressure upon the disk tends to open the valve but is counteracted by the pressure below the piston mentioned before.

The adjustment of this pressure is accomplished by a regulating valve attached to the cylinder and this valve is operated either by the governor actuated or by the pressure actuated device.

The regulating valve receives the operating water from the pipe line. Although its design is free of intricacy which would render its safe operation questionable the operating water is filtered by a pair of cylindrical screens inserted between the valve and the pipe line. These filters are so designed and connected up that either one can be cut out and automatically cleaned without requiring dismantling and without interfering with the operation of the pressure regulator. The piping is so arranged that pipe line pressure can be directly admitted below the main piston so that the disk of the pressure regulator is held closed while the regulating valve is removed for repair or opened up for inspection. The principle arrangement of these two pressure regulators is shown in the illustration. The device consists of a piston held strictly under the existing pipe line pressure and balanced by a strong steel spring, the compression of which can be adjusted by screw and hand wheel. This piston operates a lever which at its outer end carries the stem of the regulating valve. Any pressure rise will cause a compression of the spring, consequently an upward motion of the piston and the regulating valve piston. The disk valve is opened and,



Governor and Pressure Operated Pressure Regulators and Bursting Plate.

actuating the floating lever, will restore the regulating valve to its former position, thus holding the disk valve dead beat. The dashpot connected to the outer end of the floating lever allows a gradual closing of the pressure regulator similar to that of the governor operated device.

To prevent the sand from interfering with the sensitiveness of the manometric device (piston and spring) the water pressure is not directly admitted to

the cylinder but is carried into a pressure tank completely filled with oil so that this oil under pressure transmits any fluctuation to the manometric device and, due to its lubricating qualities, keeps the same in perfect condition and sensitiveness. The pressure tank has an oil glass by means of which it can be ascertained whether there is sufficient oil available to prevent the water from entering the manometric device.

Special care has been taken in the design and construction of the bursting plate and the tests to determine the proper dimensions of the bursting disk proper have shown a surprising accordance with the results figured theoretically.

Exciters.

Excitation current is supplied to the generators at 240 volts by two 225 kw. machines driven at 400 r.p.m. by impulse water wheels with hand adjustable needle regulation and governor operated deflecting hood.

The governor is of the self-contained Allis-Chalmers Company oil type. It is not connected to the central oil pressure system but furnishes its own oil pressure for regulation. This enables independent operation of the exciter units so that the field can be held on the generators irrespective of the conditions of the governors of the main unit.

The main body of the governor forms the oil tank and contains the differential regulating cylinder and piston, directly connected to the regulating shaft by means of levers and links. Attached to the body is the rotary oil pump which is belt driven from the exciter shaft and furnishes a continuous oil supply sufficiently large to handle the whole piston displacement in the minimum time required for deflecting the jet. A double acting regulating valve it attached to the outside of the pump housing. It is actuated from the floating lever, operated from the belt driven flyballs in the mid part and the relay at its outer end. The flyballs are of the equilibrated spring type of high sensitiveness and power.

The regulating valve is so designed that if placed in mid position, it allows the oil displaced by the pump to return into the receiver at a moderate over pressure.

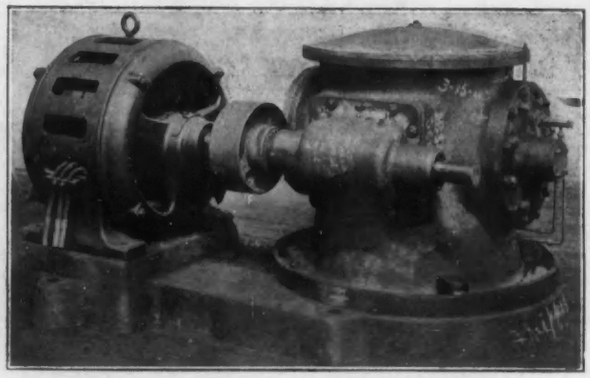
The governor is also equipped with a mechanical hand regulating device combined with the regulating piston at the rear of the regulating cylinder.

Central Oil Pressure System.

A type of pump has been adopted which, although not of the highest efficiency, is preferable on account of its reliability and simplicity. It is of the rotary type and has been brought to a remarkable degree of perfection. Three pumps are installed at present, each of a normal capacity of 90 gallons per minute against a pressure of 400 lb. per sq. in. Two are directly coupled to a 85 h.p. induction motor. The third one is also coupled to such a motor on one end and to an independent small impulse wheel of corresponding power on the other side. Pump and motor are mounted upon a common cast iron base plate grouted into the concrete floor.

The rotary pump is of the double stage type, one pump attached to one side of the cast iron housing picks up the oil from the receiver tank and discharges it at about 200 lb. pressure directly into the suction side of the high pressure pump attached to the housing on the opposite side. This pump raises the pressure from 200 lb. to 400 lb. per sq. in. and discharges into the pressure main.

The distribution of the oil pressure between the two stages is easily adjusted by a by-pass which, if once set, will require no further adjustment or attendance.



Two Stage Rotary Oil Pump.

The gears are a pair of pinions with a special design of teeth, meshing without clearance and with faces fitted carefully together with the faces of the pump housing. One pinion revolves idly around its pivot, the other pinion is keyed to the shaft which carries the driving pinion of the other pump on one end and a double helical gear in the middle. The double helical gear meshes into the driving pinion keyed upon a shaft, revolving in two rigid ring oiling bearings, and carrying a coupling on its end for rigid connection to the motor or to the impulse wheel. Special care was taken to insure perfect and reliable lubrication of all bearings. This is accomplished by automobile lubrication, whereby a small quantity of the oil pressure produced by the pump is directly used and forced through the bearings.

Exhaustive tests were made at the shops with these pumps, both in regard to capacity and efficiency as well as to heating. At a normal speed of 180 r.p.m. of the pump gears and a discharge of 98 gallons per minute against a pressure of 350 lb. per sq. in., an efficiency of the pump of 50 per cent was obtained, and air was compressed to 350 lb. per sq. in. without undue heating and with absolutely noiseless operation. The pump was also operated for a period of one hour against a pressure of 425 lb. without causing undue heating or noise.

Sufficient space was available in the basement of the power house so that all pumps, pressure tanks and receivers could be located in a compartment below the generator floor, and all pipes from and to the governors and equalizing pressure tanks are carried directly below the main floor through the basements which are easily accessible. The three pumps are set with the driving shafts in one line and provision is made for installing a fourth pump which will be required for the ultimate number of six main units.

The pumps located in the center are built sym-

metrically so that the auxiliary impulse wheel located between them can be coupled to either of the two gear shafts.

Two independent receiver tanks of steel plate are provided. They are partly set in to the basement floor, so that all oil can discharge into it by gravity. Provision is made for liberal contact of the oil with air, the oil returning from the governors or safety valves discharges over a screen whereby it frees itself of air and all impurities, as well as heat. The two receivers are interconnected by a pipe with proper valves so that the oil can be transferred from one tank to the other or the levels kept uniform. They are of ample capacity so that one receiver is capable of carrying sufficient oil for the whole system, while the other receiver may be emptied for cleaning.

A substantial concrete pier between the two receivers carries the two main pressure tanks. These tanks are made of riveted steel plate and tested to 600 lb. per sq. in. with a capacity of about 250 gallons each. A safety valve of the spring type is attached to each pressure tank and, set to any desired pressure between 300 lb. and 400 lb. per sq. in. discharges excess oil directly into the receiver. This safety valve is so designed that the valve proper can at any time be manipulated from the outside, so that the operator can always ascertain whether the device is "free and sensitive."

All piping between pumps, pressure and receiver tanks is so arranged that any combination of connection between the various elements can be established at any time during operation. It is thus possible to quickly eliminate any element of this system.

One main pressure pipe and one main return pipe carry the oil from the pressure tanks to the main governors and from there back to the receiver tanks. These pipes are 4½ in. inside diameter and made of seamless tubing annealed and bent with radii of at least 12 in. so that the flow of oil is not subject to abrupt changes in direction, which would cause pressure rams.

All connections are made by means of flange joints. The piping opposed to the view above the main power house floor is of brass as well as all valves and fittings throughout the system.

Two auxiliary pressure tanks are connected to the ends of the supply pipe in order to prevent a serious drop of pressure due to the acceleration of the oil in the long supply pipe between pressure tanks and governor. The two main and the two auxiliary pressure tanks are interconnected by an air pipe and to an air compressor located in the basement which is driven by an electric motor. By means of this piping the air levels can be equalized between the various tanks or new air quickly supplied by starting up the air compressor.

Current is generated at 6600 volts and stepped up to 65,000 volts for transmission to Seattle.

The entire engineering work for this development was in charge of the Stone & Webster Engineering Corporation of Boston, the hydraulic equipment was built and installed by the Allis-Chalmers Company and the electrical apparatus by the General Electric Company.

GERMAN DEVELOPMENT OF THE HYDRAULIC RAM.

An interesting hydraulic plant was put in operation at Hull-an-Oste in the district of Stade in October last, a plant operated by the ebbing and flowing of the tide, the purpose of which is to drain about 1,360 acres of marsh lands which lie 2½ to 3 ft. below sea level.

By means of a device denominated the hydropulsor, the flowing tide against which the shore line at Hull is protected by dikes, passes through a mechanism which, being set in motion, lifts an equal volume of landlocked water and delivers it in a reservoir, where it is impounded until the tide ebbs. At this point the hydropulsor automatically ceases to operate, and the accumulation of water in the reservoir drains out into the sea, the process repeating itself at an annual cost stated to be 75 cents per hectare (2.47 acres) as against $2 to $3 for the same drainage operations were they undertaken by steam power. These costs contemplate operation, interest, and amortization. The Prussian Minister of Agriculture was so interested in the initial enterprise at Hull that he procured $10,000 from the Government to assure the carrying out of the plan.

The construction of the plant at Hull was made possible by the development of the original invention of the "water ram" by Joseph Michel Montgolfier. Montgolfier's ram consisted of a tank to contain the power water, a conduit, two automatic valves, and a delivery conduit with delivery air vessel. The water, being let out of the tank, is bound to escape through the cut-off valve, whereby a gradual acceleration in the current takes place until the accelerating velocity causes the cut-off valve to close of itself. When the escape is suddenly stopped, the entire water mass being still in motion, the recoil produced is called the water hammer.

The original ram of Montgolfier was serviceable only for small volumes of water, as the repeated action of the water hammer strained the machine, and especially when the diameter of the valves exceeded 1½ inches. An improvement on Montgolfier's apparatus was brought out recently by Adolf Abraham, a German surveyor of public works, who instead of battering or hammering valves, provided a revolving valve that brings the power water in regular turns in connection with the discharge conduits. This device is called the hydropulsor. When the entering or power water has reached its utmost velocity of flow the revolving valve makes a turn, thus bringing the impulse of the power water to bear on the water standing in the discharge conduit, lifting it beyond its level and causing it to overflow at the orifice. Owing to the work thus performed the pressure at the intake subsides, thus causing the revolving valve to make another turn, whereupon the pressure water flows in a second time, accomplishing a new acceleration and a repetition of the former processes, which is renewed indefinitely.

It is claimed that the hydropulsor is capable of delivering the largest volumes of water, the only limits being those imposed by the manufacturers of machine parts.

DRAFTING ROOM PRACTICE

BY A. L. MENZIN.[1]

Before a possible structure existing in the brain of the designer can begin to take form as a concrete reality, it is necessary that this structure be clearly described in a language which the constructor can readily understand. Drafting is this particular language.

Every structure is built up of one or more materials of which the form, size, composition and location may vary. In the process of building the structure, various means and methods may be employed. For giving exact information relative to these particulars, a work language alone is not sufficient, since the form of objects other than the geometric figures can only be described in a pictorial way. Drafting, therefore, combines the feature of pictorial and word language in a specialized form to best serve the purpose for which it is intended.

In the commercial use of this language, the following aims should be kept in mind:

1. Utility and Clearness.
2. Speed of execution.
3. Neatness and uniformity.

The problems of how to best achieve these aims come under the scope of drafting room management, it being assumed, of course, that the designer and the draftsman have a sufficient knowledge of how the desired structure will be produced, of the tools and equipment available, the manner of erection, the skill of the men to be employed, the limitations as to size and weight for transportation, the rough handling which the materials will receive, and such other knowledge as is prerequisite to planning work, which will permit of effective and economical production. Some factors in drafting room management will be considered in this and other articles.

In most drafting rooms, the following kinds of drawings are made:

1. Sketches of minor details.
2. Preliminary drawings necessary in designing.
3. Inexpensive tracings, principally for preliminary work.
4. Pencil drawings on detail paper, to be traced with ink on tracing cloth.
5. Final tracings.

The best size of paper for sketches is letter size, which is 8½ in. x 11 in., since the sketches are most often made to accompany letters or orders for materials. It is seldom considered desirable to make blue prints of these sketches and, when copies are required, they may be readily made in the following way: Lay underneath the pencil sketch one or more sheets of blank paper with carbon paper in between, and stretch a piece of tracing paper or thin letter paper over the sketch. Trace the latter with a pencil of medium hardness, such as a 2H. The pressure of the pencil will produce carbon copies on the blank paper underneath.

Where sketches are used to any extent, it is advisable to have forms printed, which include the name and address of the company and such other information as is desirable on all sketches. This will save the draftsman much time and will give the sketches a better appearance.

In the drafting room, when designing is done to any extent, many of the important features have to be worked out by cut and try methods. The eye is a most helpful guide in proportioning materials, and it is therefore not uncommon to hear a designer say he will lay out a drawing "to see how it looks." For this purpose a cheap, unglazed wrapping paper is very satisfactory. A way of keeping this paper conveniently at hand is to mount a roll of it together with the common frame and cutter on the right hand side of the drawing table just below the drawing board. The cutter should be supported on the bottom so the paper can be unrolled by drawing it across the board.

For working on this paper, a 2H pencil is suitable for fine lines and an ordinary No. 2 writing pencil or an HB drawing pencil is satisfactory for general work. The detailer will often save himself much time if he will sketch out the desired detail roughly on this paper, fill in the dimensions from hand books or other sources of information, and then work from this sketch.

Much of the work in the drafting room is for preliminary purposes. For instance, it is desired to draw plans for a power plant. Preliminary drawings are gotten out and blue prints sent to various parties for approval, suggestions or bids. After the details are decided upon the work of making the final drawings is begun. It is not usually desirable to make the preliminary drawings with ink on tracing cloth for penciled paper tracings can be made in less than half the time. Very satisfactory blue prints can be made from these paper tracings if the penciling is well done.

Ordinarily the drawing is worked out direct on the tracing paper for which purpose a 2H pencil is very satisfactory. Afterward the lines are traced and the lettering done with a softer pencil such as an HB. On tracing paper the work should be coarser and the lettering larger than on tracing cloth.

For the final drawings the work should be accurately laid out with fine pencil lines on a good quality of detail paper. The pencil should be as soft as is compatible with accurate work, for the harder the pencil the greater will be the labor required when erasing construction lines or making alterations. For the line work a 4H pencil answers very well, and for dimensioning and lettering a 2H pencil is preferable since it is easier to letter with a soft pencil than with a hard one. A good eraser for removing pencil lines from this paper is a Ruby Eberhard Faber No. 112. For cleaning the paper, a black sponge eraser is commonly used.

After the final drawings are made on detail paper they are traced with ink on a first quality tracing cloth.

[1]Mechanical Engineer, San Francisco.

There is no right or wrong side to tracing cloth, but there is a dull and a glossy side, both of which are commonly used and give good results. However, it seems preferable to use the dull side, since pencil work can be done upon it, which is desirable for making alterations or additions. When the drawing is very simple, it may be laid out direct on the cloth instead of on detail paper.

For cleaning a tracing and removing pencil lines a soft white H eraser is very satisfactory. A 2 H pencil is suitable for work on the dull side.

Ink will not adhere readily to tracing cloth unless the surface is first prepared by rubbing it with chalk, pumice powder, etc. The dealers sell preparations put up in tin shakers or pepper boxes. A box with a removable top is more convenient for the cloth necessary for rubbing in the powder may be kept within the box and cannot easily become misplaced. Electro-silicon metal polish is put up in this way and is very satisfactory. A handy means for removing the excess powder and for general cleaning is a painter's round dusting brush.

Erasing ink from tracing cloth is an every day occurrence in the drafting room. The success with which this may be done is dependent principally on the kind of erasers used. If the ink has only been applied recently it may be readily removed with an Emerald Eberhard Faber eraser No. 111. If the ink is old a harder eraser such as a Dietzgen ink eraser No. 3361 will remove it very quickly without injuring the surface. After the ink is removed a little of the powder should be rubbed over the erased spots to prepare them for future inking. Erasers containing considerable grit, such as typewriter erasers, should never be used on tracing cloth for, unless great care is taken, a hole will easily be made in the cloth. When these erasers are used grit is rubbed into the cloth. This makes future inking with anything like clean lines impossible.

Ink may also be removed by first scraping off the surface with a knife blade held at right angles to the cloth and then removing the remainder with an emerald eraser. However, it is safer to use the knife only for removing the ends of lines which have overrun their limits. When erasing, the shield will be found almost indispensable.

Some draftsmen still use red ink for dimension lines on tracings because red lines print up much fainter than black lines. There are so many disadvantages to the use of red ink on tracings that it is not generally advisable to use it. Red ink is very difficult to erase and it does not print up on brown negatives. Besides, it requires more time to use two colors of ink than one. For the making of tracings a good quality of black waterproof ink, such as Higgins, is the only ink necessary. Differences in intensity of lines can be obtained by making them of different thicknesses.

One of the first things to be decided, when a new drafting room is opened is what sizes of drawings shall be adopted as standard. Below are given measurements of blue prints, of approximately the same size, from representative firms in the United States:

Manufacturer	22 in. x 28 in.
Manufacturer	24 in. x 29½ in.
Manufacturer	24 in. x 36 in.
Operating Co.	26 in. x 34 in.
Operating Co.	26 in. x 40 in.
Manufacturer	27 in. x 39 in.
Manufacturer	27 in. x 36 in.
Manufacturer	27½ in. x 40 in.
Construction Co.	29 in. x 35 in.
Manufacturer	29½ in. x 41 in.

It will be seen that no two sizes are alike. From these and the measurement of many other blue prints, it would seem that no one size is more popular than another. This is to be deplored, for it is a disheartening task to take the blue prints which accumulate in the average drafting room and try to file them together in some orderly manner.

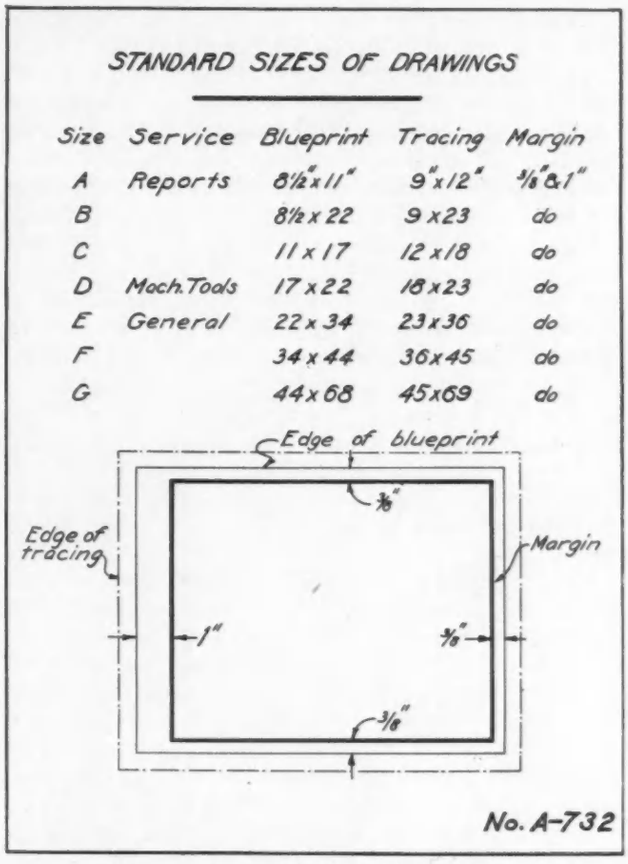


Fig. 1. Suggested Sizes of Drawings.

The standard sizes of drawings adopted should permit of the economical use of tracing cloth and blue print paper; should be convenient for office, shop and field use; and should permit of rapid folding for mailing and filing. To fill these requirements the sizes of drawings given in Fig. 1 are suggested. By sizes of drawings is meant, of course, the sizes of blue prints.

It will be seen that the first size listed is 8½ in. x 11 in. which is exactly the size of letter paper now almost universally used. The other sizes are even multiples of this basic size. Hence every size will fold, by matching the edges, to 8½ in. x 11 in., which is a decided advantage for submitting with reports and specifications. For filing purposes, vertical filing cabinets and box letter files are in very common use and, as

these are designed for paper 8½ in. x 11 in., drawings of the sizes specified may be filed with letters which they accompany, or may be filed separately in the same kind of filing devices.

Certain of the sizes listed are especially adapted for certain kinds of work. Fortunately, legal paper, which is 8½ in. x 13 in., is going out of use for reports and specifications. These are often so lengthy that, when written on legal paper, they cannot be folded in the customary way, and how to file them becomes a problem since few offices have any use for the wide filing cabinets. For the purposes stated above, letter size paper is now used very extensively, permitting the documents to be filed without folding, which is a great advantage.

The size of drawing designated as A is especially useful for accompanying reports and specifications on letter size paper since it is of the same size as the typewritten sheets, and may be bound with them.

The draftsman should bear in mind that the person for whom a drawing is intended seldom has the conveniences for examining drawings that are to be found in the drafting room, and he should select a size accordingly. This is particularly desirable when the drawing includes work to be done by machine tools, for there is seldom any place available around a machine tool for spreading out a large blue print. For machine tool work the size designated as D is very convenient. In many shops it is customary to paste or otherwise fasten the prints to sheets of cardboard for convenient reference.

Size E is about the size used for general work. The tendency at the present time seems to be to use smaller drawings than heretofore. Instead of putting different details and views on one large sheet, it is better to put them on separate sheets of a convenient size.

Fig. 1 contains all the information which a draftsman needs to enable him to turn out drawings of the standard size. It is desirable, when standard sizes are adopted, to make a sheet similar to Fig. 1 and post it in a conspicuous place in the drafting room for ready reference.

The last two columns in Fig. 1 give the sizes of tracings and margins for all sizes of blue prints specified. The sizes of tracings and the margin, may, of course, be changed without detracting from the advantages of the specified sizes of blue prints. The margin should be as narrow as will look well so as to leave the maximum of space for the drawings. It will be noticed that the margin on the right hand side is much wider than the other margins. This is to provide for binding. The consulting engineer, the superintendent of construction, and the foreman in charge will find it very convenient to bind all drawings referring to a particular job, together.

By referring to the sizes of tracings it will be seen that all sizes with the exception of the last size may be cut without waste from 36 in. tracing cloth. Aside from the fact that there is no waste, the use of 36 in. tracing cloth is desirable in the interests of economy. It does not seem to be generally realized that the wider the tracing cloth, the more it costs per square yard. To show this the following table is given:

Approximate Cost of Imperial Tracing Cloth.

Width	Cost per linear yard.	Cost per sq. yd.	Relative Cost.
30	$0.40	$0.48	1.067
36	0.45	0.45	1.00
38	0.55	0.475	1.055
42	0.60	0.514	1.142
48	0.80	0.60	1.333
54	0.85	0.567	1.26

The actual cost is somewhat less than the costs given above, but the relative cost is the same. It will be seen that 36 in. cloth is the cheapest, that 42 in. cloth costs 14.2 per cent more, and that 48 in. cloth costs 33 1/3 per cent more; 36 in. cloth should, therefore, be used when possible.

By comparing the sizes of tracings with the sizes of blue prints, it will be seen that there will be very little space outside of the blue print line for trying out pens. This is not a disadvantage as the detail paper usually extends out beyond the tracing and may be used for this purpose since it takes the ink very well.

It is generally desirable, to save time and waste of tracing cloth and blue print paper, to cut several sheets of the desired size at one time. These may be conveniently kept in metal or pasteboard tubes marked with the size, as shown in Fig. 2. The paste

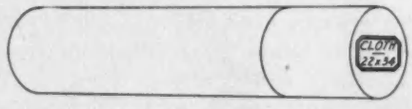


Fig. 2. Method of Keeping Cut Tracing Cloth.

board tubes are very serviceable and inexpensive, and are suitable for tracing cloth, and tracing paper as well. For blue print paper the metal tubes are preferable.

It is not necessary that all sizes be kept on hand, as some will be used very rarely. Since one size, is exactly one-half of another, two sizes may be kept in one tube and only the size most frequently used need be kept on hand.

When certain sizes of drawings have been adopted, many firms designate each size by a letter and include the letter in the drawing number for convenience in filing the tracings. Thus, Fig. 1 bears the number A-732, which indicates that the drawing is number 732 of size A. A more inclusive method of numbering drawings will be discussed in a later article.

SUCCESS OF ELECTRIC IRON SMELTER.

The electric iron smelter at Heroult, California, is producing twelve to fourteen tons of high-quality pig iron daily, at costs averaging around $14 per ton. Two more furnaces will be installed immediately and within a year the company expects to be sending hundreds of tons of iron weekly to Coast markets.

The plant is at present consuming 2000 electrical horsepower per day and arrangements have been made whereby ample electric power will be constantly delivered. In addition to the commercial iron, it is also planned to produce chrome and other high-grade steels. Users of the iron already marketed pronounce it of exceptionally fine quality, and the industry is expected to revolutionize the employment of iron on the Pacific Coast.

WESTERN LAWS OF ELECTRICITY AND WATER

RIPARIAN RIGHTS IN THE WESTERN STATES

BY A. E. CHANDLER.

The modified rule of riparian rights has been followed by California, Kansas, Montana, Nebraska, North Dakota, Oklahoma, Oregon, South Dakota, Texas and Washington; and has been rejected by Arizona, Colorado, Idaho, Nevada, New Mexico, Utah and Wyoming. Its rejection by the above States was not due to constitutional or statutory provisions but to the fact that the doctrine was entirely unsuited to the physical conditions existing in an arid region, as shown by the quotations from Jones v. Adams and Coffin v. Left Hand Ditch Co., given in the previous article. Similar language was used by the courts of the other arid States abrogating the doctrine.

The only Supreme Court holding that the doctrine has been modified by statute is that of Nebraska. In Crawford v. Hathaway (67 Neb. 325) decided February 4, 1903, it is held:

> The irrigation act of 1889 abrogated in this State the common law rule of riparian ownership in water, and substituted in lieu thereof the doctrine of prior appropriation. This legislation could not and did not have the effect of abolishing riparian rights which had already accrued, but only of preventing the acquisition of such rights in the future.

The Nebraska irrigation act of March 19, 1889, above referred to, was similar to the California statute of 1872 providing for the appropriation of water. This statute was considered at length in Lux v. Haggin—the latter party contending "that the Civil Code gives * * * * a right to the water superior to that of the riparian proprietor below." Section 1422 of the Civil Code then contained the following words: "The rights of riparian proprietors are not affected by the provisions of this title." The court held that:

> Section 1422 of the Civil Code is protective, not only of riparian rights existing when the Code was adopted, but also of the riparian rights of those who acquired a title to land from the State, after the adoption of the Code and before an appropriation of water in accordance with the Code provisions.
>
> Neither a grantee of the United States nor the grantee of a private person, who was a riparian owner when the Code was adopted, need rely for protection on Section 1422. Such persons are protected by constitutional principles.

At the first legislative session (1887) after the decision of Lux v. Haggin, section 1422 was repealed with the proviso "that the repeal of this section shall not in any way interfere with any right already vested." This repeal opened the way for a new attack upon the riparian doctrine but no serious attempt has been made. If the California Supreme Court could be induced to accept the ruling of the Nebraska Supreme Court in Crawford v. Hathaway, the riparian right would be considered abrogated for all public land not entered in 1887.

The Congressional Desert Land Act of March 3, 1877, contains the following language in one of its provisos:

> And all surplus water over and above such actual appropriation and use, together with the water of all lakes, rivers and other sources of water supply upon the public lands and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining, and manufacturing purposes subject to existing rights * * *

This language was construed by the Supreme Court of Oregon in the recent case of Hough v. Porter (51 Ore. 318) decided January 5, 1909, as follows:

> Construed, then, with the act of 1866 and other provisions of the act of 1877, we are of the opinion that all lands settled upon after the date of the latter act were accepted with the implied understanding that (except as to water for domestic purposes) the first to appropriate and use the water for the purpose specified in the act should have the superior right thereto.

Hough v. Porter was referred to by the United State Supreme Court in Boquillas Cattle Company v. Curtis (213 U. S. 339) decided April 19, 1909. The case involved a conflict between a riparian owner and an appropriator and the Court after stating that the riparian doctrine was not applicable in Arizona, continued:

> The opinion that we have expressed makes it unnecessary to decide whether land in the arid regions patented after the act of March 3, 1877 * * * are not accepted subject to the rule that priority of appropriation gives priority of right by virtue of that act construed with Rev. Stat. 32339. The Supreme Court of Oregon has rendered a decision to that effect on plausible grounds.

The Supreme Court of Washington, however, has refused to consider the Hough v. Porter rule sufficiently "plausible" to follow. In Still v. Palouse Irrigation & Power Co. (117 Pac. 466) decided August 19, 1911, the Court had before it a case somewhat similar to Miller & Lux v. Madera Canal Co., except that the defendant company attempting storage was also a riparian owner. The company contended for the rule laid down in Hough v. Porter, but the court held that "the act itself manifestly relates only to the reclamation of desert lands" and refused to apply the rule as the lands involved had not been entered under the Desert Land Act. As noted above the Oregon Supreme Court held that the rule applied to all public land, which should be the construction if the decision were rendered on "plausible grounds." The Supreme Courts of California, Montana, North Dakota and South Dakota (the remaining riparian right States to which the Desert Land Act applies) have not as yet been asked to accept the rule of Hough v. Porter and their position is therefore still doubtful.

Lateral Limits.

It has been shown in the previous article that an appropriator can neither divert nor store flood waters when such might result in damage, present or prospective, to a riparian owner. Any large project, to protect itself, must therefore purchase the riparian land or the riparian right annexed thereto—it being well settled that the riparian right may be sold apart from the land.

The generally accepted lateral limit of riparian land is the margin of the water shed. The Supreme Court of Oregon, however, in Jones v. Conn (39 Ore. 30) has held that riparian lands are not so limited but extend to the exterior boundaries of the watershed. It is the only State wherein a riparian owner, under the claim of riparian right, may divert the water of a stream beyond its watershed. The general rule is based on the idea that only those lands which border on and drain into a stream can be considered riparian thereto.

In two cases the California Supreme Court has materially restricted the lateral limits as shown by the following quotations.

> In the case at bar the stipulation is that these fourteen quarter sections were granted each by a separate patent, each patent being based upon a separate entry, and these fourteen quarter sections therefore constitute fourteen distinct tracts of land, and mere contiguity cannot extend a riparian right which is appurtenant to one quarter section to another, though both are now owned by the same person. *Boehmer v. Big Rock Irr. Dist.* 117 Cal. 27.

> If the owner of a tract abutting on a stream conveys to another a part of the land not contiguous to the stream, he thereby cuts off the part so conveyed from all participation in the use of the stream and from riparian rights therein, unless the conveyance declares the contrary. Land thus conveyed and severed from the stream can never regain the riparian right, although it may thereafter be reconveyed to the person who owns the part abutting on the stream, so that the two tracts are again held in one ownership. *Anaheim Union Water Co. v. Fuller,* 150 Cal. 331.

As later decisions have not modified the above rulings, they may be considered accepted in California. The Nebraska Supreme Court in Crawford v. Hathaway considered this question at great length and concluded:

> A riparian owner's right to the reasonable use of water exists solely by virtue of his ownership of the lands over or by which the stream flows. It is obvious that his right cannot be enlarged or extended by acquisition of title to lands contiguous to the riparian land; nor can a riparian owner, as such, rightfully divert to non-riparian lands water which he has a right to use on riparian land, but which he does not so use * * * It being the policy of the government to dispose of its public domain in tracts of not less than 40 acres each, why, then, may it not be said that riparian rights are limited to such tracts, even though several of them may be joined together in one certificate of purchase or instrument of conveyance? It is not decided that such should be the rule in this State, as it is deemed preferable to leave the question open for maturer investigation and consideration.

The Supreme Court of Texas in Watkins Land Co. v. Clements (86 S. W. 733) decided April 24, 1905, held that riparian rights "cannot extend beyond the original survey as granted by the government."

Were it not for the recent cases wherein lower riparian owners (on a showing of possible damage) have been allowed to stop the storage of flood waters by either riparian owners or appropriators, those interested only in power development might be strongly in favor of the riparian doctrine. Under it they can demand that the waters be allowed to flow to even the mouth of the stream if a power site there existed. The lower sites, however, are exceptional, and as present day developments necessitate storage, prospective power plants are as materially affected by the flood water decisions as irrigation projects. If the riparian doctrine must continue in force in so many western States, some relief can be secured by inducing the courts to further restrict the lateral limits. A general acceptance of the suggestion of the Nebraska Supreme Court that riparian rights be limited to forty acre tracts would lessen the difficulties in the way of the newer and larger projects.

The forty acre suggestion applies, of course, to public lands only. In California there are a great number of large Spanish grants, each of which must be considered a single parcel, and to such the suggestion would not apply. As those grants often extend from watershed to watershed, they contain large areas riparian to streams crossing them. While such a grant remains in a single ownership, the proprietor thereof, under the decisions cited, practically controls the streams as far as appropriators are concerned.

In the quotation from Anaheim Union Water Company v. Fuller, above, it is stated that in a partition of a riparian tract the part distant from the stream loses its riparian right "Unless the conveyance declares the contrary." A number of Spanish grants crossed by streams are now being subdivided, and the deeds are so drawn that the various parcels share in the riparian right, regardless of proximity to the stream. It is well settled that the parcels so conveyed retain the riparian right among themselves, but the western courts have not yet directly passed upon the question as to whether the owner of such a parcel not touching the stream can be considered to possess a riparian right as against an appropriator or riparian owner outside the original grant. Mr. Wiel, in the third edition of his splendid work on "Water Rights in the Western States," raises this question and after an exhaustive study of the cases bearing on the point, concludes that such parcels not bordering upon the stream cannot be considered riparian when in conflict with rights outside of the grant. The conclusion is certainly based on sound reasoning and conforms to the basic idea that only lands bordering upon a stream are riparian thereto. This question will undoubtedly be raised in the near future and the hope of all appropriators is that the courts will accept Mr. Wiel's conclusion.

In those instances where the land along the stream below a reservoir site was secured under the public land laws, the maximum limits of riparian lands (in California, Nebraska and Texas—the public lands in the last being State lands only) may be determined by an examination of the land office records, as only those forties which touch the stream or were included with such forties in the original patent can be considered riparian. Where the stream passes through lands which were part of a Spanish grant in California, abstracts of title must be examined in order to ascertain the least parcel touching the stream at one time in a single ownership. In the riparian States, other than California, Nebraska and Texas, the ordinary assessor's map showing ownership along the streams will give the riparian lands—they being those tracts in single ownership not extending beyond the watershed. The last statement must be modified for

Oregon, as there the riparian land is not limited to the watershed.

Riparian Right Restricted to Riparian Land.

On account of the riparian right being so superior (in the riparian right States) to that of appropriation, there is a popular idea that a riparian proprietor actually owns the water and is not limited to its use on his riparian land. The courts, however, have consistently held to the contrary, as illustrated by the second quotation from Crawford v. Hathaway above. Of the many cases thus holding, one presenting unusual conditions is Duckworth v. Watsonville Water & Light Company, (150 Cal. 520).

The Watsonville Company, in order to protect its diversion of the waters of Pinto Lake to Watsonville, had purchased either the riparian land or the riparian right for all the lands bordering on the lake. Duckworth leased a parcel of such riparian land, posted a notice of appropriation, initiated his diversion work and brought an action to have his water right determined as against the company. The company claimed that by the purchase of the riparian lands and the riparian rights, including those annexed to the parcel occupied by Duckworth, it was entitled to all of the waters of the lake. The following extract from the opinion. clearly presents the court's view:

We have said that the water company is entitled to a judgment protecting its riparian right, although it has not used, and does not immediately propose to use, the water on its riparian land. This rule does not apply to any right which it has acquired by appropriation or use upon other lands, and this appears to be the source of the right which it has been exercising. Such right depends upon use and ceases with disuse. (Civ. Code, 1411). It extends only to the water actually taken and used. The consequence is that, so far as the protection of this right and the water necessary to supply this use are concerned, the water company is not entitled to prevent an appropriation or use by others of the surplus of waters of the lake, if there is any.

In the last article attention was called to language used by the Nevada Supreme Court in Van Sickle v. Haines, and by the California Supreme Court in Lux v. Haggin, which characterized the doctrine of appropriation as one certain to result in monopoly. The passage quoted immediately above tells another story.

Summary of Principles.

The riparian doctrine has been abrogated in the seven strictly arid States and has been adopted in the ten semi-humid States of the irrigation zone. Of the ten, it has been held in Nebraska that the State water appropriation act annulled the riparian rights for public lands then unentered, and in Oregon that the congressional desert land act did likewise.

The doctrine restricts the right to riparian lands and allows a reasonable use of water to all riparian owners, the measure of which will depend upon the conditions of the particular case. The right is not created by use and does not cease with disuse. As between a riparian owner and an appropriator, the former is not limited by any measure of reasonableness, and may restrain any diversion or interference with the flow (including flood waters) by the latter which may result in damage to his riparian land.

Except in Oregon, riparian lands are limited to the watershed. In California, Nebraska and Texas the right is further limited to the original tract granted by the government, and in California still further limited to the smallest tract at one time in a single ownership.

It is improbable that the lateral limits may be ultimately limited in some States to the forty acre tract crossed by the stream, and that other States may follow Nebraska and Oregon in their construction of State and federal statutes. It is certain, however, that statutes annulling riparian rights existing prior to their passage are clearly unconstitutional. All such changes in the doctrine must be made by the courts and not the legislatures.

INTERNATIONAL TECHNICAL COMMITTEE'S REPORT ON WESTON NORMAL CELL VALUE.

A report to the International Committee on Electrical Units and Standards by a special technical committee appointed to investigate and report on the concrete standards of the international electrical units and to recommend a value for the Weston Normal Cell has been prepared under the supervision of Dr. S. W. Stratton, director of the Bureau of Standards, Department of Commerce and Labor.

The conclusions and recommendations are contained in the following resolutions:

(1) The committee decides to choose as the value of the Weston Normal Cell the mean value of the cells presented by the delegates of the four laboratories. This mean was determined in the following way: There was first determined the mean value of the normal cells presented by each delegate, then the mean was taken of the four numbers thus found.

(2) The committee decides to choose, for the present and until there are other mercury ohms prepared, as the value of the international ohm, to be recommended to all countries for general use, the mean of the values of the units realized at the Physikalisch-Technische Reichsanstalt and at the National Physical Laboratory. Although the international ohm as defined by the London Conference has not yet been strictly realized, the committee believes that its value has been attained in two laboratories independently with a good degree of precision, and that future work is not likely to change it by more than 2 or 3 parts in 100,000.

(3) In view of the fact that the mean of the results with the silver voltmeter obtained by this committee will probably not be changed by more than a few parts in 100,000 when the specifications are finally completed, the committee decides to recommend to the International Committee on Electrical Units and Standards the following value for the electromotive force of the Weston Normal Cell:

$E = 1.0183$ international volts at 20° C.

On the subject of the standard cells, the committee is of the opinion that new experiments are necessary before completing or changing the specifications of the London conference.

On the subject of the ohm, the committee expresses the hope that new international ohms, fulfilling all the specifications of the London conference, may be realized soon in different laboratories.

On the subject of silver voltameter, the committee is of the opinion that the specifications for the silver voltameter should not be completed until further experiments shall be made by the members of the committee in their respective laboratories on subjects which are not considered settled at the present time, and that after these experiments the committee shall complete the general specifications.

THE ACCOUNTANT IN PUBLIC SERVICE CORPORATIONS.

BY N. I. GARRISON.[1]

The accountant in public service corporations occupies a place of no mean responsibility. His duties involve matters of the greatest importance to the company. He records its transactions and determines from their character what accounts they effect. The two general divisions of corporations accounts embrace on the one side its assets and on the other its liabilities. The assets are divided into corporeal or physical assets and incorporeal or intangible assets. The rules which govern entries into the physical asset account are practically well defined and clear and will not be considered in this connection. Many of the intangible asset accounts are so closely related to the operating account that it is often difficult to determine the line of separation.

Some of the causes for certain disbursements afford debatable questions as to whether the charges should be distributed to capital or to operating account. The showing of the earnings of a company is lessened or increased accordingly as these charges are made against the one account or against the other.

As it is the business of the accountant to solve these problems of distribution it is evident, that as stated in the outset, his duties involve some responsibility.

It is the object of this discussion to consider these intangible asset accounts in the light of such transactions as furnish appropriate examples, and to prescribe some determinate rule for distributing them, and to place upon them such distinctive marks as may distinguish them from the operating account.

To this end we shall assume that A and B are two corporations, each possessed of a capital of $1,000,000. A invested his capital in an established electric light and railway business in a town of a considerable size, in a densely populated community. B took his capital into a sparsely settled country and there, in a smaller town, purchased a railway and lighting plant, and by improving its possibilities, he so increased its earnings and capitalization that, in the course of time, he developed it into exactly the same condition as was A's plant at the time A acquired it.

From the transactions of A, who acquired a property already organized and established and doing business as a going concern we hope to learn, in a general way, the nature of some of the items which represent the intangible assets of a corporation.

B purchased a plant, doing comparatively a small business. By observing his operations in the development of this small business up to the volume of A's property we shall have occasion to notice some of the purposes for which expenditures are made and the reasons for which they are distributed into the intangible assets accounts.

When A took over his property it was capitalized for $1,000,000 and was earning a fair income on that amount. It owned physical property of the value of $600,000, the balance of $400,000 consisting of intangible assets—not being represented by any corporeal property. We assume A to be possessed of competent business ability and that his investigation of the affairs of the company, before buying, established its worth, as a going concern, to be at least $1,000,000 according to the ordinary business standard of valuations in similar cases. We also assume that he found that the $400,000 of intangible assets had been embraced in the capitalization of the company by approved and legitimate methods of accounting.

If we can analyze this asset account in such a way as to ascertain the reasons which justified A in acquiring it for a valuable consideration, we shall learn something of a class of accounts which is often perplexing to the accountant in the public service corporations.

The conditions which A investigated in arriving at his estimate of the value of the property, involve some of the items which enter into these accounts. In his examination of the plant as a prospective buyer he found that the car barns and shops were located in the central part of the town, from which radiated the various lines of the system. The appraised value of the barns and shops was $30,000, although by applying the ratio of the purchase price to the physical value, he found that they would cost $50,000. A plot of ground of the size occupied by the barns could be bought at the outer terminus of the system and the buildings and machinery duplicated for $30,000, or for $20,000 less than their capitalized value. In considering the new location it was calculated that the additional cost of car maintenance and operation from the distant point was more than a fair earning on the increased cost of the central location.

He accordingly concluded that it would be better to capitalize for $20,000 more, in order to secure the advantages of a more economical and convenient base of operation. In other words it was found feasible to capitalize a location for $20,000. A certain piece of track in the center of the business district, held at $100,000, could be duplicated in the suburbs for $60,000. The passenger receipts in the business district were more than the receipts from the same length of track in the suburbs, by a sum greater than a fair income on the $40,000 difference in cost; from which he decided to capitalize for this additional amount and secure the advantages of the down-town condition; or in effect, he capitalized a condition at $40,000.

He reasoned that the location on the one hand and the condition on the other, when considered as an element in the earning capacity of the property, were just as much assets for the purpose of capitalization, as the physical property itself.

An examination of the other branches of the business disclosed the nature of the balance of the intangible assets. They consisted, in some instances, of advantageous locations and conditions, of patent rights, privileges, franchises, leases, rights-of-way, easements and such like appurtenances, which, when considered apart from their connection with the physical property, were entirely worthless, but being regarded as an essential element in the earning capacity of the plant, their value as an earning power, in some cases, far exceeded that of the physical equipment of equal cost.

[1]Auditor of the Ft. Smith Light & Traction Company, Ft. Smith, Ark.

Wherefore, A concluded that these intangible assets, by reason of their being an important and material factor in the earning capacity of the property, were proper and legitimate subjects for capitalization.

This examination of A's property has given us some idea of the general nature of the asset amounts under consideration, but it has not furnished any specific and typical examples of distributions such as might be used as a guide in the creation of these accounts.

For an observation of those transactions that furnish examples of distributions which are debatable as to whether they properly belong in the capital or operating account, we shall now consider some of the operations of B.

He bought a well equipped and modern plant for $500,000, all of which was represented by physical assets, and which was earning a fair income on that amount and no more. The remaining $400,000 of his $1,000,000 capital was reserved and afterwards used in the development of his property and distributed into intangible asset accounts, no part of this sum being used for physical improvements.

B found that the plant had been operated by an indifferent management and that its records had been loosely kept and were indefinite, and that its operation had been without system and wasteful. He reformed the accounting and introduced system and economy into the operation, thereby increasing the earnings to an adequate income on $700,000 instead of on $600,000. He took advantage of this improved condition and capitalized the $100,000 increased earning capacity. As no outlay of capital nor other factor had entered into this increased earning power, except B's ability, it may be fairly said that B capitalized his brains at $100,000.

While it is probably not an uncommon occurrence, by indirection, to capitalize brains, it can hardly be regarded a wise and safe practice to capitalize indiscriminately, the creative brains of a man who may die tomorrow and cause to fail the asset upon which the capitalization was based. However, if the business ingenuity of a man causes the inauguration of such economic systems and reforms as will cause a property, in its original condition, without additional improvements, to yield an increased profit, and these reforms be of such a nature that of their own merit, they will, in all human probability, perpetuate the additional capacity; then in that case, the cause of such increased capacity may be a proper asset for capitalization; and in this sense, it may be said that a man's brains are a suitable basis for capitalization, but not otherwise.

B organized a New Business Department and engaged solicitors to procure additional customers, and incurred much expense in demonstrations and trial installations of apparatus, and thereby further increased his income, without adding to the physical property. He kept records of the expenditures of this department and of the net profit on the business it secured. He canvassed his territory and recanvassed it, and continued until he had spent $10,000 when the diminishing returns fell below a justifiable profit on the outlay.

Up to this point the new business which he had secured was of the same general permanent character and yielded the same rate of income as the property had previously earned. In acquiring the original plant he had calculated its value to be that amount on which its income paid a reasonable profit; or, in other words, he based the value of the plant, as a going concern, on its capacity to earn. By similar reasoning he based the value of the New Business Department on its capacity to earn. As already stated the income on the new and permanent business secured by this department was the usual income on $10,000, which was the amount of its cost. B accordingly charged this expenditure into capital account.

All of the available business having been secured, and B observing that the output capacity of his plant was still greater than the demands and requirements of the population which it served, began to cast about for ways and means for enlarging the field for his operations. To this end he caused a commercial league to be organized among the business men of the town and he contributed a bonus and advertising fund for the acquiring of shops and factories.

Through effective advertising and bonuses, judiciously placed, industries were secured which used his power and employed laborers who consumed his current and rode his cars.

An electric and railway plant in a town of 10,000 inhabitants has a value limited by this patronage notwithstanding its output capacity may far exceed this demand. The same plant in a town of 15,000 population has a greater value, for the reason that its opportunities to earn are greater.

B advocated, and procured the establishment of improvement districts and their boards levied taxes against his property for the construction of sewers and the paving of streets. He regarded these improvements as an addition to the value of his plant and accordingly covered the taxes by his investment accounts.

In the course of time B found that these and similar expenditures had exhausted his $400,000 reserve without adding any physical improvement to his plant. He also found that he had increased its earning capacity to a fair income on $1,000,000 and he capitalized for that amount. He now had a capitalization of $1,000,000, represented by a physical property of $600,000 and an intangible asset of $400,000, which was the exact condition of A's concern, which we first considered.

If the foregoing examples are practical and the reasoning sound, then we conclude that the proper tests to be applied to the disbursements, to determine whether they are proper charges against intangible asset accounts, as concisely as we can state, are in effect and substance as follows:

That every expenditure that either directly or indirectly increases the earning capacity of a corporation, in a way that is stable, permanent and commensurate with an adequate income on the outlay, is properly, justifiably and legitimately a charge against capital account. These, we believe, are the distinguishing marks and this we conceive to be the general rule.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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The West as World Beaters in Engineering

It has been well said that the "race is to the swift." Our hydroelectric enterprises, having their incipiency a score of years ago in the modest little power plant of San Antonio canyon in Southern California, startled the world at that time by daring to even hope to transmit electrical energy at ten thousand volts into San Bernardino, twenty miles eastward. It is inconceivable to believe that even the promoters of this original undertaking could have dreamed the world-wide proportions to which the child of their imagination would grow upon its reaching the years of manhood.

It is interesting to recite some of the world-beating engineering achievements which have been accomplished in the West since this epoch-making period has been with us.

A corporation in its endeavors to transmit into San Francisco hydroelectric power generated in the high Sierras of California encountered the waters of the great San Joaquin and Sacramento rivers. Being navigable streams, the only feasible manner of getting power across them without submarine cables was by an overhead steel span of 4 separate wires, each 4600 ft. long and 150 ft. above the waters of Carquinez Straits. This feat is unique and unequalled today. Another company in its endeavors to supply Oakland and San Francisco with similarly generated hydroelectric power has just completed a submarine cable crossing under San Francisco bay, which for a working pressure of 12,000 volts of submarine transmission over an 18,800 ft. length cable and other features encountered in crossing under navigable waters, is equally remarkable.

San Diego, the enterprising city of the extreme southwest, in its endeavors to assure its municipal water supply, even over a series of dryest years ever to be anticipated, has just completed the Morena rock-fill dam which is 267 ft. high from foundation to the top, constituting the highest dam of its kind in the world. The citizens of Los Angeles, in synchronism with the balmy stimulating atmosphere surrounding them, are just completing the greatest municipal undertaking in the world—the Los Angeles Aqueduct. Pure mountain water is being brought a distance of 250 miles in sufficient quantity to supply a city of 2,000,000 inhabitants. The physical features met with and overcome constitute the most remarkable achievement ever accomplished under municipal guidance.

In Idaho, a State of unusual promise in development of arid land reclamation, the Minidoka Project presents another record in combination of gravity and hydroelectric reclamation. Here the U. S. Reclamation Service has in operation the largest pumping station that has been undertaken. Water is pumped for approximately 48,000 acres, the average lift being 66 ft.

The Roosevelt dam of Arizona brings its abundance of wealth to a newly-admitted State comprising a project exceeded by only one other in the world.

Under this project, 16,320 acres of land are submerged, thereby impounding 1,284,000 acre-feet of water. The dam is 1080 ft. long on top and 280 ft. high; 332,300 cu. yds. of material were necessary in its construction, its cost being $3,470,000.

The City of San Francisco swept from the face of the earth by the greatest municipal conflagration of history, today beams and smiles with its wonderful masses of steel and concrete, a fitting emblem of the brave people it represents, and today with its high pressure fire protective system, marks another epoch in municipal accomplishment.

The City of Seattle is now being supplied by power generated by recently installed hydraulic turbines of 20,000 h.p. capacity, described on another page, which again add another laurel to our triumphant West. The Big Creek enterprise of the Pacific Light & Power Company, now actually under construction, constituting a hydroelectric system, which will ultimately transmit into Los Angeles 120,000 kw. of electrical energy at 120,000 volts with two steel transmission towers each supporting six wires stretching 275 miles in length, gives an idea of the projects preparing for 1915. These projects will, in a measure, be fitting accomplishments to offer for inspection to our engineering brothers from all over the world who come to celebrate the greatest of all achievements, the digging of the Panama Canal.

Indeed, the race is to the swift, and, in the race ahead, the West—like the breathless negro when the overtaking ghost commented upon the swift running feat the negro had just performed—has but one remark to make: "Just you wait ah minute, boss, till I kitch mah breath—and den you'll see ah real race."

Capitalization of Brains

The fisherman is the only engineer, known to modern science, who makes his receipts all net. The rest of us must continually cast about for new ideas. When they are finally entangled and brought ashore, even at best, skillful application is necessary to convert the idea into an entry on the positive side of the ledger.

The successful engineer of the day is permeated with constructive imagination. Figuratively speaking, in such a masterly mind, the useful but fleeting thoughts, straying across the magnetized mental tissue, are drawn into consciousness in the shape of full blown practical ideas as surely as the iron filings are drawn from the sands along the sea-shore when the child passes a horse-shoe magnet through the playful house-fantasies it constructs near the great ocean waves.

Such a mind does not present to his superior or to the world some half-baked idea, which needs only to be pricked in a vital spot to send it to a premature death. A truly practical idea is immortal. It cannot die, though in the thundering advance of the electrical industry it may, perforce, in a season, be relegated to the junk pile. Even if this should prove to be its untimely fate, yet, as each individual link binds the completed chain, without its being brought into existence, the advance of an industry would have been crippled or impossible.

Not alone is this true in the matter of invention in physical machinery, but in the working out of the details and organization of the present day public service corporation, the brains of their constructive leaders as truly portray the divine elements of invention and genius as does the wizard in his physical laboratory.

No regulation of a corporation which causes stagnation in its progress will ever be for the good of our nation. Nor will any regulation which seeks to dull advance in efficiency and economy in the supplying of our great public necessities, aid in the working out of national betterment.

Like the god-given love of woman for man, genius is a delicate, fleeting phantom which without constant nurture cannot exist as a reality in the human make-up.

The master-mind of a corporation that in one fell stroke dreams of municipal greatness and then spends working capital in accomplishing that greatness unquestionably creates an intangible asset for his corporation, which should be credited to its account as truly as the most lasting physical reality upon the inventory. The phenomenal growth of Western greatness is largely due to the foresightedness and genius of the leaders in development of hydroelectric enterprises and its myriads of kindred industries.

The whirlwind campaign for municipal growth in inviting and subsidizing new manufacturies to enter a municipality, the issuing of bonds for school and civic bettermen, have in many cases been due to the push and energy of these genii of industry and the ledgers of many corporations show large expenditures in their behalf. The details of the duties of the accountant in public service corporations by N. I. Garrison, appearing on another page, is fascinating and instructive in illustrating this point.

It would seem that a more carefully compiled policy on the part of our public service commissions should be drawn up to protect the advance of new ideas in corporation management, the promotion of increased efficiencies and economies in power generation and above all else the encouragement of the bringing to consciousness in the brains of our corporation genii, a continuation of the train of inventive ideas which have operated for good, in our modern efficient mechanisms in the production of living necessities—heat, light, water and transportation.

It is a pity that practically all human endeavor is largely brought forth under hounding pangs of hunger or the longing for material wealth, but since such is the case, the only practical method of encouragement for such effort is a reasonable capitalization of the brains employed in the upbuilding of the modern public service corporation fabric.

PERSONALS.

Rudolph W. Van Norden, consulting engineer, is at Fresno and Los Angeles.

A. M. Hunt recently returned to San Francisco after a long vacation spent abroad, principally in Egypt.

John S. Eastwood recently returned to San Francisco after visiting Los Angeles on engineering business.

O. E. Stanley, consulting engineer at Portland, has been investigating a power proposition at Sheridan, Ore.

E. G. Williams, the manager of construction work for J. G. White & Company, has arrived at San Francisco from New York and is visiting his firm's local office.

James C. Wallace, who is connected with the construction department of the Stone & Webster Company in California, spent several days at San Francisco during the past week.

H. W. Clapp, chief assistant electrical engineer of the Southern Pacific Company's electric roads, recently made an inspection of the company's lines along the peninsula south of San Francisco.

H. L. Jackman, manager of the Western States Gas & Electric Company at Eureka, Cal., has been appointed a member of the Eureka Industrial Commission, which is inducing manufacturers to establish plants in Eureka.

H. S. Carhart, formerly professor of physics at the University of Michigan and now retired on a Carnegie pension, is now connected with the Throop Polytechnic Institute at Pasadena, where he has a special electrical research laboratory.

Robert Sibley has been appointed by the Regents of the University of California as head of the department of mechanical engineering at the State University. Mr. Sibley will continue his duties as chief editor of the Journal of Electricity, Power and Gas.

C. W. McMicken, superintendent of the Croesus Gold Mining & Milling Company, is at San Francisco for the purpose of purchasing electrical supplies for use in connection with the electrical installation operated in connection with the company's mines in Sierra County near Allegheny, Cal.

Wynn Meredith, of Sanderson & Porter's San Francisco office, has received advices to the effect that the Willapa Harbor Railway Company's new electric railway, owned by the above firm, inaugurated its regular service between Raymond and South Bend during the past week. The first trip between the two cities was made in about sixteen minutes.

The following engineers were guests at the recent banquet in San Francisco, given by the Associated Electrical & Mechanical Engineers of the University of California: C. E. Grunsky, E. C. Jones, A. E. Chandler, James H. Wise, Alexander McAdie, George J. Henry Jr., H. F. Fischer, C. W. Whitney and A. B. Domonoske. Robert Sibley acted as toastmaster.

Gano Dunn, president of the American Institute of Electrical Engineers, and Ralph W. Pope, honorary secretary, were the guests of the Los Angeles Section at a dinner at the Hotel Hollenbeck on April 11. James M. Gaylord presented a paper on "The Mechanical and Electrical Work of the Reclamation Service." Messrs. Dunn and Pope will be the guests of the San Francisco Section at dinner on April 13 and then proceed to Portland to preside at the Pacific Coast Convention, April 16 to 20.

One of the largest engineering classes in its history will be gradauted at Stanford University next month. The candidates for diplomas in the civil engineering department number thirty. Those in the electrical engineering department are: Edward N. Adam, John J. Argabrite, Ralph Raymond Beal, Thornton Easler, Herman Endres, Andrew James Field, Jarrett Townsend Lake, Sisag Vahran Melcon, Zenope Parnak Melcon, Homer Alfred Mullen, Herbert E. Pelton, Herbert Raines, Ralph Leonard Robinson, Sidney Burton Shaw, Morris Wenk.

Members of a commission of officers of the Norwegian Telegraphs and Telephones arrived at San Francisco during the past week and thoroughly inspected the two local telephone systems. The commissioners, who have covered the greater portions of Europe and America, are S. R. Abild, engineer in chief; L. Iverson, director of telephone and telegraph administration; G. Engset, commercial manager, and Einar A. Brofos, an electrical engineer of Chicago. After visiting the Pacific Northwest and British Columbia the commission will try to determine which type of American telephone systems would be the best to adopt in place of the one at present used in connection with the Norwegian Government telephone lines.

ELECTRICAL DEVELOPMENT LEAGUE.

Tuesday, April 9th, at Tait's Cafe, another record breaking attendance was experienced for the Electrical Development League in San Francisco. G. C. Holberton at the close of the luncheon called upon W. W. Briggs, chairman of the entertainment committee to make good. Mr. Briggs, in his usual happy, smiling manner, then introduced R. M. Searle, vice-president and general manager of the Rochester Railway & Light Company, who in a pleasing and interesting style, held the close attention of the hundred members for a half hour talk on the electrical art and its possibilities.

Mr. Searle began his career in the electrical industry as an office boy for T. A. Edison in 1883. He informed the men present that eastern bankers, upon learning of his intended trip to California, had requested him to make a report on electrical securities and their reason for existence in the West. "I shall tell them," said Mr. Searle, "that the invention of Burbank, the spineless castus, is the only product in this section of our country with that physical deformity." Continuing, the speaker said that he considered the electrical industry of California developed only 35 per cent at present, and that with bank clearings for the past month of $212,000,000 as opposed to $183,000,000 the previous year, together with 25 per cent increase in building permits now totaling $2,700,000 per month, San Francisco and its district had a brilliant future before it.

The speaker then touched upon the new inventions now soon to be placed upon the market in which immense increases in electric power consumption may be reasonably looked forward to. The thermostatic bed-warmer, making porch sleeping possible; the electric hot water heater, at one-half cent per off-peak current, comparable to coal at $8 per ton; and especially the Stanley stove, which by means of 3 cast iron heating units, each requiring 100 watts continuous consumption, a revolution in cooking stoves may be anticipated. Electric ventilators and ozonators, together with trolleys for electric trucks in congested cities, he prophesied would soon consume enormous electrical outputs. "I like to see a dollar turn over," declared the speaker, "for it means twenty more dollars will be added to it before it stops rolling."

The immense possibilities of iron production from the great natural ore deposits in Northern California were declared to be a great future for electrical consumption in this State, as well as adding greatly to its natural resources.

Electric processes in the manufacture of nitrogenous fertilizers were also dwelt upon very interestingly. "In conclusion," said Mr. Searle, "boost the electrical game. Don't be slow. We have a man in Rochester who is so slow it is related that he was once run over by a stationary engine. Finally, if I have said anything here, I am sorry for I am glad of it, for I am earnest in my endeavors to develop the best in all affairs electrical."

ELECTRICAL CONTRACTORS' NOTES.

The Electrical Contractors' Association will be the guests at dinner Friday, April 12th, of the Pacific Gas and Electric Company. The object of the dinner is to help the contractors and central station managers to get better acquainted, as was suggested by the Power Companies Committee of the California State Association at its last meeting.

The Electrical Contractors' Association sub-committee met with President McCarty of the State Building Trades Association to talk over an agreement to create harmony and good trade conditions through the fair period, between contractors and their employees.

W. S. Hanbridge was in San Jose Wednesday arranging with the convention committee to get things started. The San Jose boys promise a large time and hope to have all the electrical men in the State with them in August. Statesman Sanderson has placed himself on record to pull off a large rejuvenation at San Jose in August. Frank Somers will look after the hotels; John Guilbert, electric trades day; Chas. Fuser, railroad fares; R. E. Warren, entertainment. Committees from San Francisco will assist the above gentlemen in taking care of the visitors. There will be a good time for all and among the attractions planned are a dance, sightseeing trips, the annual dinner, a Sons of Jove rejuvenation, and on the last day an electrical trades day picnic, which promises to be the best ever held.

Newberry & Benheim have been awarded the wiring for the Standard Oil Building.

The Pacific Fire Extinguishing Company have been awarded the contract for wiring Hale Bros.' new store.

Chief Nixon of the Department of Electricity issued the following rule:

March 30, 1912.

To all concerned:

Feed Wiring for Apartments and Flats.

Not more than one set of feed wires will be permitted in any one circuit. Where circuits are run from apartments or flats to meter location, same will be considered as feeds.

This rule is made to do away with the possibility of having a.c. and d.c., or two separate services, in any one conduit.

WM. J. NIXON,
Chief, Department of Electricity.

TRADE NOTES.

The General Electric Company has recently completed negotiations for taking over the entire Holophane organization, consisting of both sales and manufacturing departments. The Fostoria Glass Specialty Company will be united with the Holophane organization, probably in the forms of a new company. The sales and engineering parts of the business will be directly under the charge of Mr. V. R. Lansingh, while the manufacturing will be under the charge of Mr. E. O. Cross.

On March 25th to 29th, inclusive, the sales agents of the Fort Wayne Electric Works of the General Electric Company were assembled in convention at the home office at Fort Wayne, Ind. There were about seventy-five of the salesmen, including the managers of all the district offices of the company present at the various sessions. The sessions were held in the assembly room of the fine new factory building No. 17 which is now nearing completion. The business of the convention was given over largely to illustrated lectures and discussions covering the commercial, and as well, the manufacturing side of all the company's product. On Wednesday evening of the convention there was held at the Elks' Temple a banquet and Rejuvenation of the Sons of Jove at which forty candidates were initiated. The convention closed with an elaborate banquent at wnich covers were placed for one hundred and twelve guests.

According to telegraphic advices received by Fred L. Webster at the San Francisco office, receivers have been appointed for the Allis-Chalmers Company of Milwaukee. D. W. Call, president of that company, and Otto H. Falk of the Falk Steel Company, are the receivers, with full authority from the court to carry out all existing contracts, to make new ones and to continue the business generally. A number of orders have been taken recently and business is improving. The receivership was the result of voluntary action of the Allis-Chalmers Company, made necessary by their new reorganization plan. The present capitalization of the company consists of $25,000,000 preferred stock, of which $16,150,000 is outstanding, and an equal amount of common stock, of which $19,820,000 is outstanding. The bonds outstanding amount to $11,148,000. The plant, upon which about $10,000,000 has been expended for new construction, is said to be in fine condition.

PACIFIC GAS AND ELECTRIC MEETING.

At the regular annual meeting of the stockholders of the Pacific Gas and Electric Company at San Francisco, on April 9th, the following board of directors was elected to serve during the ensuing year: Frank B. Anderson, Henry E. Bothin, John A. Britton, W. H. Crocker, E. J. de Sabla Jr., F. G. Drum, John S. Drum, D. H. Foote, A. F. Hockenbeamer, C. O. G. Miller, Wm. G. Henshaw, John Martin, Samuel Insull (Chicago), Louis Sloss, George K. Weeks. The following officers were re-elected: President, F. G. Drum; first vice-president and general manager, John A. Britton; second vice-president and treasurer, A. F. Hockenbeamer; secretary and assistant treasurer, D. H. Foote; assistant treasurer, Jos. C. Love; assistant secretaries, Chas. L. Barrett, Morris K. Parker (New York). The new directors are C. O. G. Miller, Wm. G. Henshaw and Samuel Insull. The two first named are well known to the community and represent individually prominent local interests. The entry of Mr. Insull into the directorate is significant in connection with the recent purchase by Mr. Insull and other influential Eastern associates of 40,000 shares of the common stock of the Pacific Gas and Electric Company from the estate of the late N. W. Halsey, as recently announced through the press. Mr. Insull is president of the Commonwealth Edison Company of Chicago and is also prominent in connection with other large public utility enterprises.

The following income account statement for the year 1911 was presented:

Gross revenue		$14,604,609.30
Expenditures for maintenance, operation, taxes and reserve for uncollectible accounts, casualties, etc.		8,214,071.97
Net revenue		$ 6,390,537.33
Bond interest		3,254,133.27
Balance		$ 3,136,404.06
Preferred stock dividends	$600,000.00	
Sinking fund payments	773,226.54	
Amortization of bond discount and expense	75,671.84	1,448,898.38
Balance		$ 1,687,505.68

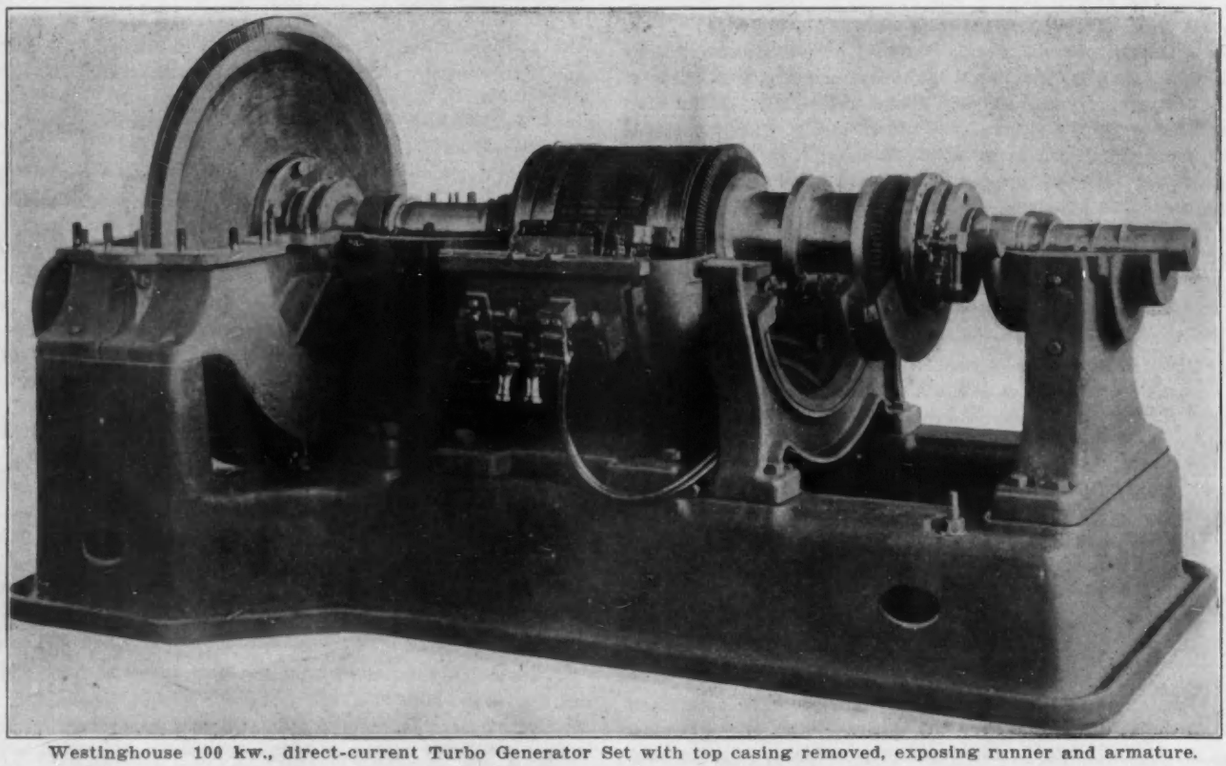
It was announced that the company was entirely free from floating debt, had an ample cash working capital and was also well provided with funds for future construction and plant enlargements.

General Manager Britton's report showed that during the year the company constructed 408 miles of additional gas mains, 125 miles of electric transmission lines, 500 miles of electric distribution lines and 4.1 miles of street railway track. This in addition to the installation of a 20,000 Curtis steam turbine in San Francisco, a 16,000 h.p. Curtis steam turbine in Oakland and a 6,666 h.p. Curtis steam turbine in Sacramento. It was also announced that the company, preparatory to the influx of population that will follow the opening of the Panama Canal, had plans in progress for the construction of additions to its hydroelectric plants aggregating 101,000 h.p. One interesting feature of the plans for additional hydroelectric generating capacity is the construction of a reservoir with a capacity of 30,000,000,000 gallons of water, a sufficient quantity to supply the entire needs of the city of San Francisco for three years.

INDUSTRIAL

WESTINGHOUSE DIRECT-CURRENT TURBO GENERATORS.

Westinghouse type T, direct current, turbo generator units find wide application where a simple, compact, reliable generating set is desired. Many are used for exciter sets in alternating current generating stations, for lighting and power in industrial plants and in office and apartment buildings, for storage battery charging in railway signal work, and for train lighting. They are particularly applicable for exciter service in modern generating stations where the steam pressure exceeds 125 lb. per sq. in. because small reciprocating engines ordinarily used for driving exciters are usually designed for pressures not greater than 125 lb. per sq. in. Where the boiler pressure exceeds 125 lb. per sq. in., a reducing valve must be used with such engines. Type T turbines operate directly on pressures up to 200 lb. and with steam superheated to 150 degrees Fahrenheit.



Westinghouse 100 kw., direct-current Turbo Generator Set with top casing removed, exposing runner and armature.

As compared with reciprocating engine sets the features in favor of the Westinghouse turbo-generator set are:

Simplicity—Reliability—There are few moving parts such as rods, levers, eccentrics, and cranks. There are few parts that require attention because of wear, there are very few bearings to oil, and no stuffing boxes to pack. There are no reciprocating parts to wear out and no steam cylinders to be oiled.

Compactness—A reciprocating engine set occupies from one-half again to several times as much (depending on the speed and other characteristics) space as does a turbo-generator set.

Lower Cost of Installation—The first cost and the installation cost are less for a turbo set than for an equivalent reciprocating engine set. Expensive foundations are not required for a turbo-generator unit.

There is no oil in the exhaust steam. The line of Type T sets includes machines of the capacities most in demand of from 10 kw. to 200 kw. standard voltages are 125 and 250. Three-wire generators—125 and 250 volts—can be supplied. The steam pressure range is from 75 to 200 lb. per sq. in. Either shunt or compound wound generators can be furnished. Standard compounding is 118 volts, no load, and 125 volts, full load or 235 no load, and 250 full load. Compounding can be varied by adjusting the shunt.

The turbine is of the single wheel impulse type. The wheel or rotor is mounted directly on the end of the generator shaft. Although only one impulse wheel is used an unusually high efficiency is obtained by using the steam two or more times on the one wheel. The governor is of the fly-ball type. The weights are hung on hardened steel knife edges, minimizing friction. In case of overspeeding, the automatic safety stop throttle valve is tripped, shutting off the steam supply.

Type T generators are of the commutating type which insures sparkless commutation with a fixed brush position at all loads within the capacities of the machines.

A complete oiling system of the type best adapted to the service is provided with each turbine. In the smaller sizes the well known ring oiling scheme is employed. In the larger turbines the oil is circulated through a closed system, by means of a rotary pump driven by the main shaft through positive gearing.

All parts of the turbine are readily accessible for inspection or repair. The upper half of the cylinder or casing may be removed without interfering with the valve or governor mechanism, and, if necessary, the wheel or rotor may be entirely removed from the casing.

Generally speaking, the steam consumption of turbines of small powers compares favorably with the performance of automatic high speed engines of similar capacity. As Westinghouse turbines are carefully tested in the shop before shipment, there can be no uncertainty as to their performance. The guarantees of steam consumption are based on an average of actual test results, plus a comfortable margin.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The United Electric Company has been incorporated for $50,000, by J. A. Raisch, E. L. Zimmer, G. C. Collins.

PASADENA, CAL.—Pasadena Consolidated Water Company, $200,000, subscribed $400, by J. B. Coulston, J. C. Brainard and Kate M. Denny.

COLFAX, WASH.—The Whitman County Telephone Company has been organized and will incorporate with a capital of $100,000, shares to be sold at $10 each.

LOS ANGELES, CAL.—The Little Rock Power & Water Company has been incorporated with capitalization of $500,000, by G. P. Jewett, R. L. Burcham, C. W. Morrell, C. J. Cradall and G. E. Vermilyea.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the Washington Storage, Electrical, Manufacturing & Automobile Corporation, with capital stock of $50,000. They will manufacture an improved storage battery, the invention of Prof. Wm. R. Bawker of Coronado, who is secretary and treasurer of the new company.

BOISE, IDAHO.—With a capitalization of $900,000, articles of incorporation were filed for the Snake River Power Company. The incorporators are all Boise men and the object of the company is to furnish lights and power at low rates for the city of Boise. They will irrigate land along the Snake River with pumping plants. The construction of the power plants will start immediately.

OROVILLE, CAL.—The Feather River Power & Irrigation Company, a corporation backed by W. P. Hammon, the dredger magnate, has filed articles of incorporation. The company is capitalized for $10,000,000 and will build a power plant in the Feather River Canyon. It owns water rights in both Butte and Plumas counties, and will irrigate land in both these counties. The directors of the corporation are A. N. Lewis, Jr., H. J. Hill, A. L. Dahl and S. O. Vandernse.

ILLUMINATION.

ROSEVILLE, CAL.—Roseville will receive bids up to April 29, for the construction of a new electric distributing plant.

CONCONULLY, WASH.—The County Commissioners have granted the Nixon-Kimmel Company a franchise to extend their lines to furnish lights to Pateros and Brewster.

RIALTO, CAL.—Bids will be received up to May 21, for the sale of an electric franchise to maintain for a period of 50 years, an electric pole and wire system in the city.

FLORENCE, ORE.—At the recent election here the vote was in favor of granting G. G. Bushman, of Sheridan, a franchise to build, equip and operate a light plant in the city.

POCATELLO, IDAHO.—Ex-Governor J. H. Brady has ordered machinery for increasing the capacity of his company's hydroelectric power plant at American Falls, by an additional 4000 h.p.

CLARKSTON, WASH.—The Pacific Power & Light Company, which operates a system of gas lighting in Clarkston, has made application for a 50-year franchise to place and maintain gas pipes in Vineland.

CORONA, CAL.—The Pacific Light & Power Company has been granted a franchise to construct and for a period of 50 years to operate and maintain an electric pole and wire system upon all streets and alleys in this city.

VALLEJO, CAL.—At a metting of the City Council it was announced that the rates of the Pacific Gas & Electric Company in this city will be cut. The new tolls will not become effective until July 1. It was also stated that a reduction of 25 per cent on all telephone tolls will be made by the city fathers.

SALINAS, CAL.—A. M. Frost, representing the San Joaquin Light & Power Company, which has taken over the electric propositions at San Miguel, Paso Robles and other towns in San Luis Obispo county, recently bought Ulrey's plant at King City, and have applied for a blanket franchise to erect power lines on all the county highways. His application was received and ordered advertised.

PORTLAND, ORE.—The lighting and bridge committee of the City Executive Board, has voted to award the contract for installing lights on the Morrison street bridge to the Northwest Electric Engineering Company, for $3837. The contract for doing the work on the Hawthorne avenue and Burnside bridges was awarded to the West Coast Engineering Company, for $6140 on the Hawthorne and $3407 on the Burnside. When the equipment is installed, lighting facilities will be had, not only for adequate lights for traffic, but an elaborate system of decorative illumination will be supplied.

HONOLULU, T. H.—At a stockholders' meeting of the Honolulu Gas Company last week, plans were favorably discussed for an increase of the capital stock of the company by $50,000 and an increase of $100,000 in the company's bond issue, with a view to financing extension of the company's system. The capital stock is now $300,000. It is proposed to make it $350,000. There is a bond issue now outstanding of $200,000. The plan discussed at the meeting was to call in this issue and float a new loan of $300,000. While the matter was not definitely acted upon, it is understood that the stockholders are practically all in favor of it, and it will probably be carried out.

OAKLAND, CAL.—That there may be greater competition in the bidding for contracts to supply street lights than in the past, the city has been divided into five districts, and bids will be accepted for each district. Sealed bids will be opened April 22 at noon. The concerns expected to enter bids are the Pacific Gas & Electric Company, the Great Western Power Company and the Central Oakland Light & Power Company. Section 1 includes the district southwest of Market and Thirty-sixth street; section 2, the district north of section 1; section 3, that remaining portion of the city west of Lake Merritt and Grand avenue; section 4, East Oakland to Fruitvale avenue, and section 5, the remainder of the annexed district of East Oakland.

TRANSMISSION.

QUINCY, CAL.—It is reported that O. C. Pratt, president of the Indian Valley Light & Power Company is arranging to extend the transmission lines from Greenville to Crescent Mills, Taylorville and Indian Falls, early in the season.

RIVERSIDE, CAL.—The Southern Sierra Power Company, which is building a three-phase transmission line from Bishop to San Bernardino, has requested permission to build a pole line over certain of the city's streets. An application placed before the council intimates that the company would, with the city's permission, sell electric energy within the city limits. Action on the application has been deferred for one week.

RIVERSIDE, CAL.—With the letting of the contract for the steel pole line between San Bernardino and Riverside, the Southern Sierras Power Company announces that it expects to be able to deliver power by May 1. Scores of miles of distribution lines have been built in Riverside County, and an auxiliary steam plant is nearing completion at San Bernardino. That city is the objective point of the three-phase

transmission line being built from Bishop in Inyo County. The company will furnish light for the towns of Hemet, Corona, San Jacinto, Perris and Elsinore.

TULARE, CAL.—The Tulare Power Company has started up the big battery of boilers in its power plant northeast of this city for the first tryout since the plant was installed. Everything was found in excellent condition and following the test Manager C. H. Holley of the company announced that the company would be furnishing current in eight days. The first circuit to be turned on will be that running from this city to Lindsay and the Lindsay district. One hundred pumping plants have been connected up and wired in this district, representing approximately 1000 h.p. The Tulare and Exeter circuitss will next be turned on. The present plant is a steam plant and is ultimately intended to be an auxiliary, the main plant to be located on water power sites near Springville. The steam plant has contracted to deliver power April 15, and will be in shape to do this before the date set. It has been announced also that the company will extend its lines to Terra Bella and vicinity. C. H. Jackson, superintendent of the company, has sent the first carload of poles to Terra Bella and these will be strung immediately.

NEZ PERCE, IDAHO.—The Lewis County Power Company has been incorporated in Idaho by A. Welch and R. B. Montague, of Portland, Oregon, to develop 125,000 horsepower on the Salmon River, the plant installation and transmission lines, representing an investment of $3,000,000. Construction work is to begin shortly and pushed to completion. The driving of a 4,000-foot tunnel through a narrow ridge provides a fall of 200 feet and empties the water again in the river at a point about seven miles below the point of intake. The initial plans provide for the driving of a tunnel through the ridge that will carry sufficient power to develop 40,000 horsepower at the beginning and the further development will be secured by the driving of a second tunnel or the enlargement of the first one. The completion of the plans will develop the 125,000 horsepower at a cost of $24 per horsepower, these estimates providing for the construction of the 200-foot dam across Salmon River at the point of intake, the driving of the necessary tunnels, the installation of the electrical equipment and the construction of the transmission lines. Mr. Welch and associates became interested in the central Idaho country a year ago, when the Nez Perce Power & Light Company was acquired. Transmission lines have since been extended to Ilo, Vollmer and Kamiah.

TRANSPORTATION.

REDWOOD CITY, CAL.—A franchise for a street railway system has been granted to Edward F. Fitzpatrick, who according to the terms of the franchise will start at once the construction of electric lines in Redwood and the vicinity.

EL PASO, TEX.—Stone & Webster state that work will start on the valley interurban line as soon as a bonus of $60,000 has been deposited with some bank in El Paso, pending completion of the road; deeds to necessary right of way furnished and all other necessary rights secured.

PASADENA, CAL.—It has been reported that the issue of $2,000,000 worth of bonds of the Pasadena Rapid Transit Railroad Company has been sold to an English syndicate. The line will now be built from Pasadena to Los Angeles. Articles of incorporation for the company were filed December 31, 1908, with capital stock of $3,000,000. G. H. Hayes, W. H. Smith and Horrace M. Dobbins are directors.

DANVILLE, CAL.—John Baldwin, N. S. Bonne and Charles Goold, who are circulating the stock subscription list for the San Ramon Valley Railroad in this section, have thus far secured subscriptions totaling over $63,000. The railroad, which will be seven miles in length, will be a branch of the Oakland and Antioch electric line, connecting at Walnut Creek, and will traverse San Ramon Valley.

MARTINEZ, CAL.—Henry C. Cutting of Richmond has secured an order calling for the sale on May 6 of a franchise for an electric railway through the town of Pullman and along that portion of Cutting boulevard lying outside the city limits of Richmond. It is understood that Cutting is seeking the franchise for the Southern Pacific Railroad, which is planning to extend its Berkeley suburban lines north into Richmond.

LOS ANGELES, CAL.—The Pacific Electric Company has bought from the Pacific Light & Power Corporation, the Ontario & San Antonio Heights Electric Railroad for approximately $1,000,000. Paul Shoup states that the Pacific Electric line to San Dimas from Los Angeles will be extended 6 miles within six months, to connect with Pomona. It is said also, that right of way agents are buying land for an extension of the Stern line of the Pacific Electric out of Los Angeles to connect with the Arlington line out of Riverside. The Pomona City Council has granted the Pacific Electric a 20-year franchise for operating interurban cars through the city's streets.

WILLOWS, CAL.—The executive committee of the Sacramento Valley West Side Electric Railway has ordered a survey from Woodland via Dixon to a point on the Sacramento River, touching the line of the Oakland, Antioch and Eastern electric line. The distance from Woodland to the point of connection with the Oakland line is about 33 miles. A new survey in Colusa County for a branch has been ordered also. It will run from Williams to Colusa and will touch the Northern Electric in Colusa, the Vallejo Northern in Woodland and the Oakland and Antioch near Rio Vista. The right of way department is having great success in obtaining free rights of way. In Yolo County, from Woodland to the northern boundary of the county, the line covers 28 miles. Twenty-six miles of the right of way has been obtained.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded the contract for the completion of the Geary street municipal railway from Kearny street to Fifth avenue to Bates, Borland & Ayer of Oakland for $225,025. The firm is allowed fifteen days within which to sign the contract and 180 days within which to complete the work. A protest against accepting the contract on its own bid was made at the last minute by the contractors, but Mayor Rolph and members of the Board of Public Works refused to permit a withdrawal of the bid, and ordered the contractors to proceed under the specifications on pain of forfeiture of the certified check for $25,000 which was filed with the bid. Mayor Rolph explained the situation, bringing out the fact that the bid of Bates, Borland & Ayer was $28,000 lower than any other received and approximately $50,000 less than the estimate of the city engineer.

TELEPHONE AND TELEGRAPH.

SEDRO-WOOLEY, WASH.—Work is progressing rapidly on the branch line of the interurban from Burlington to this city. It is expected cars will be in operation by July 1st.

ELK CITY, IDAHO.—Wm. Sherman has gone east to interest capital in a proposition to build an electric railroad from Stites to this city, to handle the products of the mines.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company has been formally petitioned by the residents in the Geneva district to extend its line to that place.

OAKLAND, CAL.—Plans are being prepared for a 4-story brick and steel addition to the Exchange Building to cost $50,000, on Franklin street, near 15th, for the Pacific States Telephone & Telegraph Company.

COLFAX, WASH.—Work of constructing a trunk line of the new Whitman County Telephone & Telegraph Company will be commenced immediately, the line to extend from Colfax to all principal Whitman county lines for a connection with local exchanges throughout the county.